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PRICE 15 CENTS.

JANUARY 29, 1887.

THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL. XXI. REGULAR EDITION NO. 579.

ARCHITECTVRE

ENGINEERING

DECORATION

CONSTRVCTION

TICKNOR & COMPANY

BOSTON · MASS.

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House on Fairfield Street, Boston, Mass.
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Church near Chalons-sur-Marne, France.
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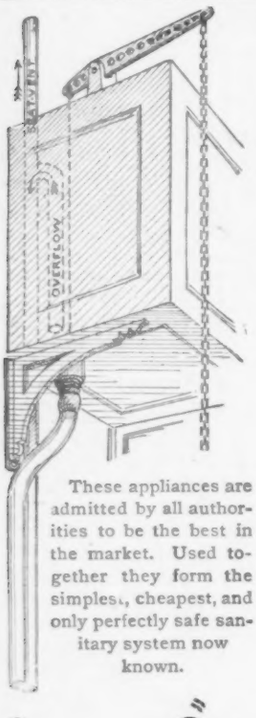

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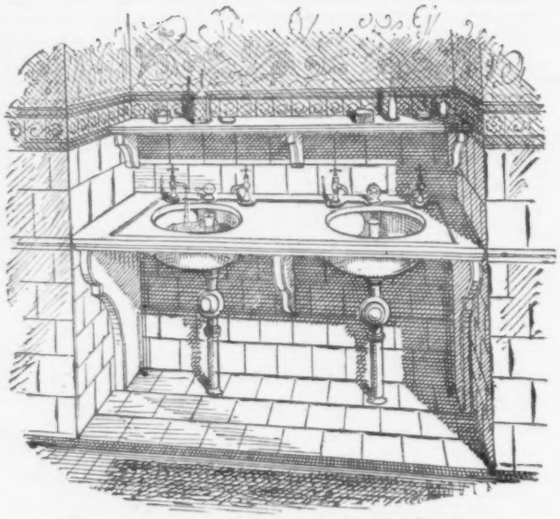

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Entered at the Post-Office at Boston as second-class matter.

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DR. WERNER SIEMENS, one of the most distinguished men of science now living, stirred up, a few years ago, a rather lively controversy in the scientific world by a suggestion that it might be possible, after the world's supply of coal and wood had been exhausted, to warm the chilled bodies of the unfortunate men of that period by means of some application of electricity as yet undiscovered; with which he coupled also the idea that it was at least conceivable that similar means might be employed for nourishing the human race after all vestiges of plant life had disappeared from the earth. It is not unlikely that even scientific men are fond of a good dinner now and then, and the idea of feeding on electric currents seems to have been more than they could endure; for Dr. Siemens was attacked with considerable warmth as a visionary, who amused himself with idle fancies instead of scientific reasoning. A few months ago, however, the venerable philosopher took occasion to explain his theory, which, curious as it is, is, as he says, anything but the idle fancy which it was accused of being.

SCIENCE believes, said Dr. Siemens, in the interesting address which we find quoted in the *Schweizerische Bauzeitung*, that all substances have, connected with them, a certain portion of energy, which, like the elements with which it is associated, is indestructible; modifying often its form and relationships, but always traceable and constant throughout its changes. When a substance combines chemically with another, it often happens that the compound substance formed by the combination, by some quality of its constitution which we know nothing of, associates itself with a smaller relative proportion of energy than that proper to the substances of which it is composed; and in the act of combination this surplus of energy, which no longer finds a place in the new substance, is set free, and manifests itself as heat or light. The burning of coal is a familiar example of this. The carbon of a given quantity of coal, and the oxygen with which that quantity of coal will unite, possess more energy than the carbonic acid formed by the union of the two elementary substances; and in that union the excess of energy is disengaged as heat. The same thing takes place when wood or any other substance is burned. Now it is remarkable, that although we can obtain this manifestation of surplus energy, to warm our hands with, by the combination of many of the substances now existing around us, the separation of the compounds, so that we can combine their elements again when we want more heat, is a very different matter, and when all the coal and wood are gone we shall find it very hard to get them back again out of the carbonic acid into which we have resolved them. In fact, there are only two common agencies by which the bond between chemical compounds can be directly dissolved. One of these is light, the decomposing effect of which is as yet not well understood, and the other is electricity, which is now constantly used to effect chemical decomposition in the arts. It is certainly not unreasonable to suppose that we shall some time use it more effectively for this purpose than we now do, and, although the decomposition of carbonic acid, or of water, which is perfectly practicable, would yield rather unmanageable gases, it is, as Dr. Siemens says, quite within the bounds of possibility that the mechanical force derived from wind, or falling water, or waves, converted into electricity by revolving magnets or otherwise, may hereafter be used for producing, by decomposition, potassium, or magnesium, or some other solid, portable, and tolerably effective fuel.

WHILE we could reconcile ourselves, if necessary, to the idea of sitting around a potassium fire on winter evenings, there would be still a considerable step to be taken before reaching the production of food by electricity, and here Dr. Siemens only ventures to indicate rather vaguely the way which he thinks it possible that science might follow. So far as we know, the most essential element of food is nitrogen, which we consume in combination with a great variety of other substances. Now these combinations of nitrogen with other substances are effected in nature mainly by the obscure processes of vegetable life, nitrogen in its natural state having no disposition to combine with other elements, even when aided by heat. By indirect chemical action it is possible to force nitrogen into combination with oxygen, to form nitric acid, and with hydrogen to form ammonia; but neither of these substances are edible, and after all vegetable life had disappeared from the world, we should certainly starve if we had nothing better than such things to depend upon. Here, however, electricity comes to our aid, in a new way. Although one form of electric current, that of low tension, forms the most powerful decomposing agent we know, a current of high tension may be made, either directly or by induction, to exert a powerful combining force. By passing the sparks of an induced current of high tension through air, the condition of the atmospheric oxygen is changed. It becomes ozone, and in that form seizes upon the nitrogen with which it was before only mixed, and combines with it, forming a vapor of nitric acid, which shows itself to our senses by the "sulphur smell" which follows the sparks of a frictional electrical machine or a Ruhmkorff coil, or a flash of lightning. Whether nitrogen may by similar means be made to unite with carbon, hydrogen and the other elements of organic substances, is for the electrical chemistry of the future to decide; but it cannot be said that it is scientifically impossible.

THE *Wiener Bauindustrie-Zeitung* says that the Egyptian Ministry of Public Works is at present very busy with a scheme proposed by a well-known American gentleman, Mr. Henry Cope Whitehouse, for refilling and putting in order what Mr. Whitehouse believes to be the Lake Mœris of the ancients, a depression situated in the fertile district of the Fayoum, not far from Cairo. The original lake, according to the ancient writers, was an enormous artificial basin, more than four hundred miles in circumference, and three hundred feet deep in some places, which was excavated about 1350 B. C., as a storage reservoir to retain a part of the overflow water of the Nile, with which it was connected by canals. The lake being below the high-water level of the river, the water flowed into it through the season of inundation, and out of it during the low-water season, but the amount of water stored in it was so large that it served not only to supply the plains in the neighborhood, but to increase the flow through the lower Nile itself, until the time of inundation returned. Besides the excavation of the lake, a work in comparison with which the cutting of the Panama Canal is a trifling affair, the Egyptians built various permanent structures in or near it, among which were two pyramids, each six hundred feet high, and crowned by sitting figures, which stood in the middle of the lake, and commemorated its construction. For more than a thousand years this huge piece of engineering fulfilled its purpose admirably, converting the desert region about it into a rich and fertile district, and bringing prosperity to the numerous towns and cities supplied by its waters; but during the dark ages which succeeded the Roman period it was allowed to go to decay, and its site is now only marked by the remains of some of the more important buildings

which stood near it, and by a small natural lake which is considered by some to occupy a different position from that of the ancient excavation.

MR. WHITEHOUSE, who, as we have heard him say, took the novel course for an Egyptologist of going to look at the objects in which he was interested, before beginning to theorize about them, was struck with the appearance of the district in the neighborhood of the ruins of the Labyrinth, and of the scanty traces discovered by Linant Bey of what he considered to be the commemorative pyramids of the lake, and made such observations as he could to determine whether the level of the district, relatively to that of the Nile, was such as to render it possible that it could ever have been overflowed from the river. Nothing is more difficult than to estimate such relative levels without the most perfect instruments, but he thought he could trace something of the ancient engineering, and satisfied himself that it might yet be possible to restore the work of King Mœris to its original usefulness. His early impression, on more mature consideration, seems to have been confirmed, and he has apparently been able to bring the able men who manage public enterprises in Egypt so far over to his views that a party of engineers is to be sent at once to make careful surveys and levels over the whole region.

THERE has been a good deal of talk for some time about the establishment in London of a "United Arts Club," to include architects, artists and others, the members of which should enjoy the privileges and conveniences of ordinary clubs, as well as the society of men of similar tastes and acquirements, and a beginning has been made by the formation of an association, under the presidency of Mr. Edward I'Anson, the President of the Royal Institute of British Architects, which has already engaged temporary quarters at the St. James Place Hotel, in St. James Place, in the middle of the club region of London, and invites gentlemen interested in the scheme to meet and take steps for the permanent establishment of the club. All persons engaged in the study and practice of architecture, the other fine arts, and engineering, are eligible, and it is intended, as soon as circumstances will admit, to buy or build a house which, in addition to the usual reading, dining and conversation rooms, shall contain bedrooms for the accommodation of members not residing in London who may visit the city. This, which is a very popular feature of the Union League Club in New York, would probably be still more popular and useful in a club of architects and engineers, and if the dues of non-resident members are made as moderate as is now intended, the club might easily, we should think, secure a large membership out of the city, among persons of the most desirable sort, who would find their connection with it at times very pleasant and convenient. Of course, only a small proportion of the out-of-town members would ever be in London at the same time, so that a comparatively small club would serve a large number of people of this kind, and experience shows, we think, that a good non-resident connection, which is not much influenced by the shifting fancies prevalent among young men in the city, helps materially in promoting the permanence of such an association. Among the names of the architects interested in the scheme which the *British Architect* gives are those of nearly all the most distinguished men in the profession, and the club certainly ought to be one of the pleasantest and most successful in London. If it should prosper as we hope it will, it is likely that American architects and artists who have the necessary introductions will find as kind a reception in it as it is possible to give, and the courtesy which is so much cultivated between clubs in good standing is likely to be conspicuously shown where artists, architects and engineers are concerned. Curiously enough, the most distinguished and exclusive club in this country, and the most successful, judging from the eagerness with which membership in it is sought, the famous Century of New York, has always contained a very large proportion of artists and architects, and there are several other well-known clubs in other cities which show by their membership lists that these two professions seem to fit their votaries in a remarkable degree for club life. Whether this is creditable to them or not we will not here inquire, but the fact seems plain that men of the imaginative turn of mind which all artists have in some degree, and which engineers share with them to a greater extent than is generally supposed, enjoy congenial society more than most other people do, and this makes them agreeable and amiable members of social associations.

THE *Architect* quotes from C. Waterton a suggestion about dry-rot which is worth remembering. According to Mr. Waterton's definition, dry-rot is the "decomposition of wood by its own internal juices, which have become vitiated for want of a free circulation of air." We should rather say that the vitiation or fermentation of the confined juices prepared the conditions for the development of the dry-rot fungus communicated from without, but this may, perhaps, be considered the same thing. Whether the effect of the corruption of the sap is direct or indirect, it seems to be becoming every day more certain that a free circulation of air is the best preventive and remedy against the dry-rot infection. Mr. Waterton gives some striking illustrations of this from his own experience. After remarking that in nine cases out of ten wood is painted too soon, and that dry-rot is liable to occur from the interruption, in this way, of the access of air to the sap-tubes, he says that he had occasion to alter a house, and put down a new baseboard, of apparently well-seasoned pine, to match the old work, and had it immediately painted. The base was set on the inside of a stone wall, which was, however, furred with studding and laths, and plastered down to the floor. The pine baseboard, enclosed between the plastering on one side and the coat of paint on the other, soon began to be affected. Four months after it was put down, a yellow fungoid growth began to appear from beneath it, and on taking it up, not only the baseboards, but the laths and the lower ends of the furring studs, were found to be completely rotten, a portion showing the characteristic phenomena of dry-rot, while the rest was somewhat moist and covered with the mushroom-like growths of the fungus. A new plinth was then put down, having holes bored through it, three feet apart. This, after many years, remained perfectly sound.

TO test in another way the effect of a circulation of air in preventing the attack of the disease, Mr. Waterton procured some new larch poles. Half of these were set up against the wall inside an unused barn, while the rest were simply set up on the outside of the same barn, leaning against the wall, with their feet on the ground. Within a year, the poles inside the building were attacked with dry-rot, and were used for fire-wood, while those outside, although resting at one end on the damp earth, never showed any signs of decay, and were only removed after they had become thoroughly seasoned and secure against any bad effects from decomposition of their sap. The question here involved, of the influence of a still, slowly-changing atmosphere, even in a room of considerable capacity, in favoring the growth of dry-rot, has, we think, hardly received the attention that it deserves. The numerous cases in which floors over unventilated cellars have rotted and fallen in are, we are convinced, too often attributed to the dampness of the cellar, instead of the stagnation of the air in it. We remember a somewhat striking instance in illustration of this, where, in the garret of an old building, a shore had been set up to sustain the middle of a principal rafter, which had split in seasoning, and was bending under its load. The shore rested at the lower end on a sole of timber, about six inches square, and at the other end was wedged under the principal. None of the timbers were painted, and the garret, though unventilated except by the percolation of air between the slates and boarding, was as dry as any room could well be; yet the sole timber was so rotten that it could be broken to pieces with the hand, and the shore was approaching the same condition. The roof-timbers, which were of pine, and had probably been in place a hundred years, were in excellent condition, and the explanation of the decay of the newer pieces seems to have been that when the shore was set up, with both ends wedged against other timbers, thus closing the ends of the sap-tubes, evaporation, in that still atmosphere, could not take place rapidly enough laterally, through the walls of the tubes, to prevent the fermentation of the juices; and after this had once begun, the same circumstances favored the germination of dry-rot spores, which are probably always present in the air, in the decomposing matter, and the development and propagation of the disease so long as it could find material to nourish it. It is well known that rot almost always shows itself in a favorable atmosphere, where the end grain of one timber abuts against the side of another, and Mr. Waterton's explanation of this, that the closing of the tubes checks the evaporation of the sap in a dangerous degree, is probably the correct one; and it is quite possible that if the shore in the college garret had had two or three auger-holes bored in each end, to expose a part of the pores, the slow movement of the air about it might have been sufficient to save it from destruction.

JOINTS IN WOODWORK.

CAST-COPPER LECTERN. XV CENTURY.

IT would be an indubitable advantage in the construction of our buildings, if framers and carpenters more generally understood the principles which govern the form of joints in woodwork. Many of the most important joints are commonly executed in a manner which is bad in workmanship and improper in form, and to prove the truth of this it will only be necessary to examine any of the less important of our buildings.

Professor Rankine, in his "*Civil Engineering*," and Tredgold, in his "*Carpentry*," have dealt with the subject of joints in a very comprehensive and thorough manner. The forms for various joints recommended by these authors are substantially the same, and are, to a considerable extent, followed in Europe. Here in America, joints in woodwork are generally executed in a much more crude and imperfect manner, even in the best work, where the form is as a rule simpler and less perfect.

The reason for this is not far to seek. In any country like this, where wood is abundant and labor expensive, the system of construction will be different from that used in countries where labor is comparatively cheap and timber dear. The effect will be to simplify the construction to a considerable extent, and to save labor in the execution so far as possible, even at the sacrifice of material.

These conditions have had a considerable influence on the general forms of joints, with the result of producing a quantity of bad work. The question of the adoption of any particular form of wooden structure, which requires the use of more or less timber with a corresponding loss or gain in the labor required upon it will be simply determined by the local cost of labor and materials, and the comparative loss or gain in the two items; but with joints the matter is different.

The strength of any structure must be as the strength of its weakest part, and in most wooden structures the joints necessarily form the weakest portions, so that if the strength of the joints is lessened by imperfect workmanship or improper form, the strength of the whole structure is thereby lessened in a corresponding degree. This has the effect of not only lowering the strength beyond safe limits, but of directly causing the absolute waste of a considerable quantity of material. For example: the members of an ordinary roof of some magnitude are usually much stronger than is actually required under normal conditions, the object being to provide for the effect of the pressure of high winds and for other emergencies which may arise. Some idea of the extent to which this is done may be obtained from the fact that, while it is usual to allow only 8 cwt. per square for the weight of slates and timbers, and much less for shingles and felting, as much as 36 cwt. per square is allowed as the probable wind pressure on the roof in times of gales and hurricanes.

Such emergencies are provided for by the use of timbers of sufficient size to resist such force, should it be applied. But if, in joining these timbers together, the connections are badly, carelessly or improperly formed, the full strength of the timbers can never come into play at all, for if a very high wind take place, the joints will fail under the exertion of a force much less than the roof would safely carry with such timbers properly jointed.

In determining the form of a joint, it should be striven to produce a strength as near to that of the solid piece as is practicable. Rankine, in his work before referred to, lays down a number of rules upon which the form of a joint depends, and the reader interested in the subject will do well to refer thereto. For our present purpose we can consider that the following points chiefly determine such form: (1) The direction of the load; (2) the description of the load; and (3) the nature of the materials to be joined.

As characteristic examples we will consider two cases. In the first place, the joint used in connecting a collar to the rafter in a collar-beam roof. The description of strain here is important, as strictly determining the form of joint. Occasionally a carpenter is found who is under the impression that as the effect of the weight on the roof is to cause the rafters to sag to some extent, the collar must be subjected to a direct compressive strain, and that the best joint is a butting one, as shown in Figure 1. This is altogether wrong. The only possible condition under which the collar could be compressed is where the feet of the rafters are immovable, and even then (a condition impossible to produce in practice) the sagging, and consequently the pressure upon the collar, could not be more than would result from the very slight lengthening of the timber due to the elasticity of the material.

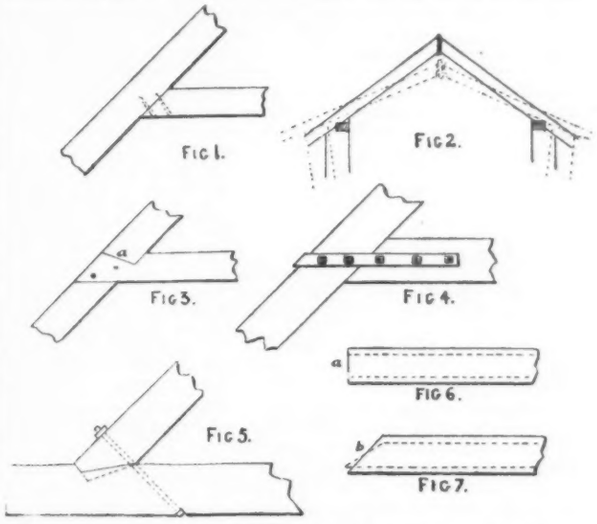
The strain to which any member of a roof truss or other simple structure is subjected may always be found by determining the manner in which such structure, if overloaded, would fail. Thus in the present case the effect of an overload would be to throw the rafters out, as shown by dotted lines in the case of a single pair of rafters in Figure 2. The effect of a load, even that of the weight of the timber composing the roof, would be to *tend* to throw out the rafters in the same direction. The object of the collar, then, is to simply tie the two rafters together, and prevent them spreading out, and the collar is therefore clearly subjected to a tensile or pulling strain.

It is apparent that, such being the strain, the butting form of joint before referred to and shown in Figure 1 would be almost useless, and would in fact depend for its strength entirely upon the adhesion of the nails joining the two parts. Nevertheless, partly from ignorance, this joint is used, and very frequently, even where the strain is understood, to save labor the collar is simply nailed upon the side of the beams.

The proper form of this joint is that shown in Figure 3, in which a portion, usually about one-third of the depth, is cut away and the collar halved on and pinned in place. The inclined edge *a* prevents the piece from being withdrawn, and hence effectually resists the strain. Sometimes this joint is formed by fitting the collar on the rafter with a tenon, and connecting it with an iron strap, as shown in Figure 4; but this construction is only employed in roofs of large span.

The form of joint, if such it can be called, shown in Figure 1, although not infrequent, is a fair example of the manner in which timber may be wasted by bad construction, for the sake of saving a little labor. Can it be doubted that this is very far from true economy?

As an example of strains unlike those just referred to, we will take the case of the joint between the foot of the principal rafter and tie-beam of a king-post roof truss. There is the same tendency here for the rafters to separate as in the preceding case, and the effect is to throw the tie-beam strongly into tension, and the strain on the joint will be a compressive one. The load being communicated to the tie-beam by the rafter at an acute angle, a special provision is necessary in forming the joint. The most important point is to form the butting surfaces at right angles to the thrust, and this is provided for by letting the rafter into the tie-beam, as shown in Figure 6. Then, as there is some tendency for the rafter to slip out of its place, a tenon is provided, forming the joint usually termed the shouldered tenon, as shown in Figure 5. There is a tendency, too, for the rafter to rise



out of its place, and, to prevent this, a bolt is passed through the two, or in large trusses an iron strap is placed around, to embrace the two and keep them from separating. Other forms of this joint are sometimes employed, some having two tenons and others two bearing surfaces, but their use is limited. It is not necessary to illustrate here, the various bad and ill-considered forms of this joint in common use. The example in Figure 5 is the simplest form which should be allowed, even in unimportant work.

In the proper construction of this joint, it is obviously important to place the end of the rafter far enough back from the end of the tie-beam to prevent detrusion or splitting off of the wood. Hurst gives the following rule for finding the distance. Let *a c* equal the required distance in inches; *B* equal breadth of tie-beam in inches; *H* equal horizontal thrust in pounds, and *S* the cohesive strength of a square inch of the material.

Then $A.\ C. = \frac{4H}{BS}$

The time occupied in the execution of this joint is, of course, somewhat long, but it is of so much importance (for the whole stability of the roof depends upon it) that the inferior forms so often seen, some without tenons at all, others without straps, would never be adopted by a good workman.

A consideration of the nature of the material to be jointed is of importance in determining the description of joint to be used. The most important characteristic, so far as the question of joints is concerned, is the manner in which it shrinks. It may be taken as a fact that any alteration in the length of a piece of timber by shrinkage is inappreciable, but the shrinkage in the direction of its width is considerable. This fact will have an important bearing on the form

and execution of joints. If a piece of timber be cut off at the end at right angles, it will, on shrinking, still retain the same shape. If the end be cut at an angle, the effect of shrinkage will be to make the angle more acute. In other words, let the full lines in Figures 7 and 8 represent pieces of timber cut at right angles and obliquely, respectively, as shown. When the timber shrinks to the position shown by dotted lines, the end *a* will be unaltered in shape, but still retain its end perpendicular with the body; while the end *b*, shrinking in the same manner, will be altered, becoming more acute, as shown by dotted lines in the figure. Framers should remember these facts, and make allowances for the alteration in shape, and especially when working upon timber unusually sappy.

When a joint is not quite true, it is usual to run a saw-cut between the abutments, to produce a better bearing, but as timber all shrinks to some extent, it is well not to make the abutments fit too closely at first, provided always that the inequality is properly allowed to be compensated by the subsequent alteration in form which will take place from the shrinkage, as explained. Artus.

BOOKS AND PAPERS.

Had Palissy[1] lived in the nineteenth century he would undoubtedly have been set down as a crank, and a most persistent one at that, for he was a man of one idea, spending fifteen years in hard, unremitting toil in search of something which brought him only ridicule, and, after all, was but in part a new discovery, having been known and made use of a generation earlier in Italy. He was not a genius, perhaps, but he had the willingness for hard work, which was worth more to him; and the amount of enthusiasm he brought to bear on his ideas, not spasmodically or on special occasions, but steadily and persistently during all his discouraging career, shows how terribly he was in earnest over his rusty pots and blackened earthenware. A complete history of his life has never been written, for almost the only records we have of him are contained in his own scanty writings, and he was always so wrapped up in his precious enamels that he quite forgot to say anything about himself except as a crank to the revolving wheel of invention. We know that he died in prison in 1590, at the age of eighty, and that he was a native of Saintonge in Brittany, as bigoted and immovable in his faith as a Huguenot as he was in his art. In 1652 he nearly lost his life through his zeal for his religion, being only saved by the interposition of Catherine de Medici, who brevetted him with the doubtful title of "*Inventeur des rustiques figulines du Roy.*" By his own admission he was a person of lowly birth, poor, ill-educated, devoured by misery in his home, where he had naught but a scolding wife and a numerous brood of hungry children, and wracked by the passion for his art in his workshop, where year after year the only results of his labor would be a heap of broken, discolored earthenware. His whole being was absorbed into one idea — to produce a white, glazed enamel on earthenware. What started him in such a direction we know not. Perhaps it was the sight of a Chinese vase in some of the collections at Fontainbleau where he might have been called in his earlier capacity of ambulating artist-decorator. Had he been a person of means he would have gone to Florence and endeavored to learn the secret of the white enamel from the Della Robbias, but as it was he had to begin at the very beginning of everything, examining earths, rocks, chemicals and combinations, ignorant of how to fire his pottery, even to build his furnace, and yet in it all showing a keenness of judgment and an unwavering pursuance of his idea which could not fail to ultimately bring him success. The story of his trials sounds like the fable of the industrious ant. He was years in learning that different enamels fuse at different temperatures, and years more in producing modified mixtures of equal fusibility. His sent his pottery to a factory to be burned and every piece was destroyed. He tried to burn them himself and his oven was destroyed. He thought his furnace finally in proper order, and, for lack of money to buy fuel, he was obliged to burn up his garden fences, his floor, and even the tables and chairs in his poor house. But his furnace failed, and though the glaze on his pots was such as to delight his heart, each piece was stuck over with bits of his furnace lining which had gone to pieces in the heat; and, as he says himself: "*Je mys en pièces entièrement le total de la ditte fournée, et me couchay de mélancolie non sans cause, car je n'avois plus de moyen de subvenir à ma famille.*" So many things which seem simple to us now were so dark and confused to him then. We know little of Palissy's successes. His narrative deals only with his failures, and though he tells us exactly how he fell short and what he was striving to do, he carefully refrains from telling how he succeeded, or from what his white enamel was finally obtained, as though he feared some one would rob him of the hard-earned fruit of his years of toil.

The Palissy ware, with its linings of ugly toads and fishes and loathsome reptiles, is too well known to all art amateurs to require any description. Palissy considered white enamel as a basis for all colors, and though white really appears but little in his ware, it was the object of his most cherished hopes. His figures were all taken from living models, if we may believe a contemporary writer, the snakes, fish, leaves and fruit being arranged on a brass dish and secured in place until a plate-mould could be cast over them. They are never beautiful in themselves, but when considered as the evolution of a single man who was obliged to invent everything connected with the process of their manufacture, they possess a priceless value, which is the greater from the rarity of authenticated examples.

M. Burty's biography is not easy to read, being tedious in its statements and unnecessarily confused in arrangement of the subject matter, but it is accompanied by a number of excellent engravings of the best of Palissy's works, which go far to make up for any looseness of literary style.

[1] "*Les Artistes Célèbres, Bernard Palissy,*" par Phillippe Burty, Inspecteur des Beaux Arts. Paris: Libraire de l'Art, J. Rouam, Editeur.

A few days ago, in passing through Essex Street, Boston, we missed an old landmark, an old wooden dwelling-house, with indications in cornice, door and window, that in times past gentler-mannered inhabitants than the denizens of the "South Cove" had sheltered within. Standing just where it would have been swept away by the great fire of 1872, were it not for that curious habit which great conflagrations have of making most rapid progress by eating their way against the wind, it is now replaced by one of the most commonplace of the new business structures which are nowadays forming a group of the finest mercantile buildings in the city, where only a few years ago was one of the most squalid quarters of the town, and a very few years before that one of the quiet nooks where not a few aristocratic families of conservative tendencies preferred to live, rather than migrate to those new-made lands in the Back Bay district. Where the shore-line ran when this old house was built, in 1734, we do not know, but it could not have been far from this place, and it was presumably a pleasant dwelling for the so-styled Captain Child, who, though only a distiller and sugar-baker — whose still, within a year or two, if it does not even now, sent forth an odor at times which warmed the heart's cockles of him who does not abhor New England rum — was yet the grandfather of Lieutenant-General Sir Roger Sheaffe, Bart. It may have been prophetic instinct that caused the artist to make the closing illustration of the book [2] before us a view of this old house in its last estate — a junk shop.

This book shows that for him who cares for such things, and knows where to look, there are old buildings in Boston which have real historical, much picturesque and some architectural value still left, and the fate of the Sheaffe house and the transformation of the quarter where it stood — whose fate suggests that society, like crops, has a rotatory movement — shows that capital will not much longer allow them to remain the home of the foreign proletariat.

The North End, the original Boston, is still largely covered with low wooden structures, inhabited once by men who made the history of Boston, but now the homes of the Hebrew, the Portuguese, the Italian and the Irish, who, not having any cause for venerating the homes in which chance has housed them, have maltreated them, and though by so doing they have aided age in producing a picturesque air of decay, have also hastened the time when they must all become things of the past, concerning whose identity and appearance the curious student must seek for information on the library shelves, where he will find not the least useful and reliable information in the faithful delineations which this book will lay before him. Boston i far from being commercially a dead city, and the water-front now being fully occupied with warehouses, it will not be long before an inner ring of similar structures will be built, which from the formation of the shore-line at the North End will absorb the greater part of the space now occupied by dwellings, and the inhabitants, both the old ones and they who belong to the great unwashed, must "move on." When that time comes, we trust that in the new buildings will be incorporated, after a fashion that has obtained to a considerable degree in Boston, whatever in the way of relics the demolition of old historical buildings may yield, and so unite the new buildings with the old ones, as do with the buildings of which they now form a part, the "Boston Stone" in Marshall's Lane, the "Painters' Arms" on Hanover Street, the "Green Dragon" on Union Street, the "Wadsworth Tablet" on North Street, the "Bell in Hand" on Williams Court, and other fragments, which clearly are of use to succeeding generations, as they are by them put on inquiry, and are brought face to face with incidents and personalities which it is not well that the youth of Boston should ever forget.

A book that is made because the book-maker is in love with his subject, and not because he sees in its making a possibility of making a profit, is more often a book well made and worth making than one over whose inception and development the shades of Pluto have hovered. In this case the illustrator, whose careful work is deserving of much praise, was the originator of the book, and his starting-point, we believe, was a series of sketches prepared some years ago for publication in this journal, but which a fortunate delay on our part enabled him to withdraw when he had become more fully informed as to how much material of the kind a little careful research would enable him to gather together. But illustrations, fascinating as they may be, do but superficially tell a story, and the local coloring is more of this day than of the past. Words are needed to fill out the picture and restore to the mind's eye what the eye itself cannot

[2] "*Rambles in Old Boston, New England.*" By the Reverend Edward G. Porter. Illustrated by George R. Tolman. Boston: Cupples, Upham & Co., 1887. 439 pp. 93 illustrations.

perceive. For this is needed the aid of some one who can not only write in an agreeable style, but who has been possessed by the zeal of the historical student long enough to be thoroughly familiar with his subject, and so be able to approach it from a personal standpoint and give his work the vitality which is too often lacking in such books. In a very marked measure Mr. Porter has succeeded in making his work readable and interesting, when taken in detachments — as it may well be, since little attempt has been made to weave the disjointed fragments into a connected picture of life in Boston a century or two ago. In a certain way this would have been impossible, but it seems to us that Mr. Porter went astray in not furnishing an introductory chapter, which, by rehearsing the story of the social habits of the citizens in the last century, should put the reader into the properly receptive humor to thoroughly appreciate the bearings of such facts and legends as are recounted in connection with the brief descriptive histories of the several buildings illustrated.

WE have seldom read a preface that was so well worth reading as this short page with which Mr. Bruce Price introduces to the observer — not to the reader, for there is nothing else to read save a specification — the full and interesting series of plates which illustrate the building of a large house at San Mateo, California, a house, by the by, which was illustrated in this journal a few weeks ago. In a few words he shows more clearly where lie the germs of an American style — well-grown ones, too, and far past the dicotyledonous stage — than many a lecturer and essay-writer has succeeded in doing after much more laborious effort. Mr. Price's feeling seems to be that, as everybody has to have a home, it is in the houses that are built and not in the churches, schools, stores, or other buildings that the style must develop, and he holds that the American "cottage" is already *sui generis*, and we incline to agree with him. To be sure, as he says, many of these cottages would be styled in England mansions, in France châteaux, and in Italy villas, but with us they are only cottages and their fashionable inhabitants are still cottagers, so-called. But the type, the germ from which they developed, is the story-and-a-half cottage which can be seen in the older settled parts of the country in the course of any day's drive, and when seen is sure to call from the feminine members of the party enconiums on its snug cosiness and restful homelike air. Little enough of rest some of its earlier imitators had, but fortunately architects have learned their lesson and now simplify their groupings and details much more than formerly. The prevailing fashion of building country-houses has given them opportunity of repeating their experiments, and, as repetition implies increasing familiarity with the requirements and possibilities of the problem it has enabled them to forget tradition and put more intelligent individualism into their work, and so fashion the work that it adapts itself more closely to the real needs of American habits of life and climate than could any anterior or foreign style, however good in itself and in its own proper place.

The book,[1] which contains some two dozen folio plates, is the first of a series on "Modern Architectural Practice," and is much more likely to be of service to architects than the similar publications which this publisher has put forth in the last few years, which, excellent as they are and vastly superior to the works published by the same house a dozen years ago, are more likely to be purchased by the man who proposes to build without an architect's aid than by the architect himself; but as books are made to sell and as architects are a small body when compared with the rest of the world, this is probably just what the publisher likes. The book is made up in an exceedingly attractive style.

THE BLACK-PROCESS.

ENGLISH CHAIR.

FROM THE *Monitour des Architectes*.

A BLACK-process, which will compete for favor with the well-known blue-process familiar to engineers and others, is given in the *Photocopie* of Mr. A. Fisch. The process is technically known as heliography, is simple, easy, and inexpensive, while the prints are ink-black, and are made from drawings or positives and negatives. We owe this process to Mr. Poitevin, but it has been slightly improved.

Sensitizing Solution. — Dissolve separately.

1. Gum arabic,		13 drams.
Water,	17 oz.	
2. Tartaric acid,		13 drams.
Water,	6 oz.	6 drams.
3. Persulphite of iron,		8 drams.
Water,	6 oz.	6 drams.

The third solution is poured into the second, well agitated, and then these two solutions united are added to the first, continually stirring. When the mixture is complete, add slowly, still stirring, 100cc. (3 fl. oz. 3 drams) of liquid acid perchloride of iron at 45° Beaumé. Filter into a bottle and keep away from the light. It keeps well for a very long time.

Sensitizing the Paper. — Here especially it becomes necessary to select a paper that is very strong, well sized, and as little porous as possible. By means of a large brush or sponge apply the sensitizing liquid very equally in very thin and smooth coats; then dry as rapidly as possible with heat, without exceeding, however, a temperature of 55° C. (131° F.). The paper should dry in obscurity, and be kept away from light and dampness; notwithstanding all these precautions, it does not keep well long, and if it is desired to act with some certainty, it is better to have a stock to last only a fortnight. Freshly prepared, it is better than a few days afterwards. It should be of a yellow color.

Printing.—The tracing, made with very black ink, is placed in the printing-frame, the drawing in direct contact with the plate; then place over it the sensitized paper, the prepared side in contact with the back of the tracing. There is no necessity to make use of photometric bands, as the progress of insolation is sufficiently seen on the sensitized paper during the exposure. From yellow that it was, it should become perfectly white in the clear portions; that is to say, upon which there is no drawing of the transfer or positive cliché that is to be copied. This is ascertained by raising, from time to time, the shutter of the frame. The exposure lasts from ten to twelve minutes in the sun; in summer less, in winter more. When the exposure is ended, remove the print from the frame, and it should show a yellow drawing upon a white ground. If in the sensitizing bath a few cubic centimetres of a rather highly concentrated solution of sulphocyanide of potassium have been added, this bath becomes blood red, and colors the paper the same; in this case the print also whitens during exposure, but then the image, instead of being yellow, is red, on a white ground. This substance, however, is, if we may so speak, inert, or without any other action; it is very fugitive, and even disappears in a short time in obscurity; it has no other use, therefore, than to render the drawing or the image more visible after exposure.

Developing the Prints. — When the print has been sufficiently exposed, it is taken from the pressure-frame and floated for a minute in the following solution, so that the side upon which is the image should alone be in contact with the surface of the liquid, avoiding air-bubbles between the two surfaces. Otherwise defects would be found in the print. To ascertain this, raise in succession the four corners. The developing-bath is composed as follows: —

Gallic acid (or tannin)	31–46 grains.
Oxalic acid,	1½ grains.
Water,	34 oz.

In this bath the orange, yellow or red lines are changed into gallate or tannate of iron, and form, consequently, a veritable black writing-ink, as permanent as it. The print is then plunged into ordinary water, well rinsed, dried, and the print is now finished. The violet-black lines become darker in drying, but unfortunately the ground, which appears of a pure white, often acquires, in drying, a light violet tint. For prints with half-tones, this is of no importance; but for the reproduction of plans, for example, it is very objectionable. By this process we have the satisfaction of obtaining a drawing in black lines similar to the original, and in most cases this is sufficient.—*Engineering News.*

THE ILLUSTRATIONS

[*Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.*]

HOUSE OF WM. G. SALTONSTALL, ESQ., FAIRFIELD STREET, BOSTON, MASS. MESSRS. PEABODY & STEARNS, ARCHITECTS, BOSTON, MASS.

[Gelatine Print, issued only with the Gelatine and Imperial Editions.]

FISHERMEN'S HOUSES, CAPE ANN, AFTER AN ETCHING BY STEPHEN PARRISH.

MR. PARRISH, one of the best etchers of the day, was born in Philadelphia, in 1846. He began to use the etching needle in 1879, his interest in the art having been aroused by some plates of Appian's. His earlier subjects were taken from scenes on the Schroon and Delaware Rivers, and in Pennsylvania and New Jersey. Then his fancies travelled farther north, and he produced a number of plates drawn from the Cape Ann fishing-towns — Gloucester, Annisquam, and Marblehead — and later found congenial themes on the New Brunswick and Nova Scotian coasts. Though Mr. Parrish has executed a number of etchings, wherein the beauties of a country landscape are well portrayed, his greatest successes have been won with pictures of harbor and shore; and he is never, to our mind, at his best away from the smell of salt water. In 1884, there was privately printed a "Catalogue of Etchings by Stephen Parrish, 1879–1883," which contained a descriptive list of all his etchings made during that time, some eighty in number. Since then Mr. Parrish has travelled in Europe, and etched a number of plates in Normandy, Spain, and England, among which we may specially mention his views of "Greenwich" and "London Bridge." Other important plates, some

[1] "*Modern Architectural Practice, No.* 1." A large country-house. By Bruce Price, architect, New York. William T. Comstock, publisher. Price $5.00.

of which are very large, are "November," "Old Fish-House," "The Shepherd's Christmas Eve," "Low Tide, Bay of Fundy," "Portland, N. B.," "Coast of New Brunswick," and "Midsummer Twilight," and reproductions of the late W. M. Hunt's "Gloucester Harbor," and W. H. Brown's "Venice — Morning of the Carnival." His last plate, entitled "A Gloucester Wharf," is in dry-point, and, although the first which Mr. Parrish has made in that medium, is a most successful one.

We are indebted to Messrs. Frederick Keppel & Co., the well-known New York print-sellers, for permission to reproduce Mr. Parrish's etching.

CHURCH OF NOTRE DAME DE L' EPINE, NEAR CHALONS SUR MARNE, FRANCE.

The appearance of this print in the *Moniteur des Architectes* enables us to republish it and so add to the information which, in such meagre measure, we were able to furnish a correspondent who, some months ago, asked us for particulars about it.

COMPETITIVE DESIGN FOR THE ALGONQUIN CLUB-HOUSE, BOSTON, MASS. MR. CARL FEHMER, ARCHITECT, BOSTON, MASS.

ACADEMY OF MUSIC, MACON, GA. MR. ALEXANDER BLAIR, ARCHITECT, MACON, GA.

PARIS GOSSIP.

Recently one of my friends suggested the possibility that the door of this journal might be open to me. Howsoever slight an opening you are willing to make for me, allow me to try and slip through, and permit me to address to you this courier of Paris, for which I beseech your indulgence.

I must, then, speak to you of Paris, and unfortunately, this subject is extremely unpromising at this moment. All Paris is just coming back from the baths, the sea, and the country. The vacations are hardly finished, and we have only had time to unveil some statues, among others that of Berlioz in the Square Ventimille, the work of the sculptor, Alfred Lenoir. All this is sufficiently stale. Nevertheless, a great deal of noise is made at the moment, and people are agitating themselves extremely on the subject of the Metropolitan Railroad and the Exhibition. This last enterprise is entering on the period of execution, and workmen have taken possession of the Champ de Mars, where they are already at work on the excavations and terracing. There is much discussion also over the Eiffel tower. There is a general feeling of disquietude as to the effect of this gigantic tower — too gigantic when compared with the rest of the structures. For my own part I fear that the result will be far from satisfactory from the point of view of art. Nevertheless, I sincerely wish to find myself deceived, since, in the eyes of certain people, the success of the exhibition of 1889 seems to roost at the top of this iron tower, three hundred metres in height.

As to the Metropolitan Railroad, I wait the publication of the exact route it is to traverse before speaking about it. What this route will be it is not yet definitely determined. It will be partly subterranean and partly elevated, but which part will be below ground and which above is still under discussion.

That which is always interesting at this season at Paris is the annual exhibition of arts as applied to industry, interesting particularly for us architects, who can take note of the progress, the improvements and the discoveries of everything which, from far and near, has a bearing on architecture — furniture, ceramic products, lighting, heating, ventilation, etc. Everything that serves our need and our comfort is there; but how many steps still remain to be taken in this path, and what advances still remain to be realized! One feels everywhere a great desire to make comfort perfect, but I think that we are still far from perfection, and in expressing this opinion I do not speak only of the comfort which can always be procured by the wealthy, but of that practical and not luxurious comfort which ought to belong to all and in a general way serve our everyday needs. Take, for example, a matter with which people have concerned themselves for some years to such a degree that all our walls are covered with placards advertising continually the last invention of the kind. I speak of heating. It must be confessed that we don't know how to warm ourselves. We know how to burn wood or coke in the fireplace. This warms one room. We pass into another and we freeze. In winter our apartments are like Scotch douches, where one is played upon by a warm jet and alternately with a cold one. We have not yet found a practical means of warming the whole house by means of a furnace, a thing which will be ultimately accomplished, I hope. We see on all sides, rolled in on wheels, movable stoves and fireplaces, which do not warm us badly but asphyxiate us far more successfully, and every day we see spring up a new and "perfect" system, "absolutely safe," which proves that the system which was last discovered was worth absolutely nothing — a fact which would seem to prove that systems in general are n't worth much of anything. Ah! when shall we see heaters capable of warming our house from top to bottom and spreading through all the rooms a uniform warmth? Here is something, I believe, which would satisfy everybody, and the proof of it lies in the relative success of all of these stoves on wheels, whose only merit is that they can be moved from one room to another. In this way they succeed in bringing it about that we do not have too great variations of temperature in the same room. But how far from practical is all this!

At this time there is a very fair exhibition of stained glass at Champaigneulle. I will mention among others a fragment of a superb window intended for the Cathedral at Metz, of most brilliant tonality. This window measures ninety square metres.

At the Louvre the former Salle des Etats, closed for many years, was a few weeks ago opened to the public. M. Guillaume, architect to the Louvre, has made of it one of the most beautiful halls of the Museum. It is very well lighted through the ceiling, whose frieze, which is very rich, is occupied by a range of medallions extremely well arranged, representing the principal artists of the French school. Under each of these medallions, which number sixteen in all, is a garland of flowers, and on each side figures of genii which form a very elegant and well-studied motive. Above the two doorways, still in the frieze, are two vessels' prows, upon which are tall draped figures. To this hall have been carried many paintings, which, many years ago, were banished to the upper stories of the Louvre, and also some more modern paintings: "La Baigneuse," by Ingres; a panoramic landscape, by Chintreuil, charming with its morning freshness and light; two chef-d'œuvres of Tryon, "Oxen Going to Work," and "The Return to the Farm"; several Theodore Rousseau's; Courbet's "Combat of Stags"; several Dalacroix; among others "The Taking of Constantinople," which used to hang in the Museum at Versailles.

Now, what more can I add of interest? We are unfortunately at a time of year when the artistic movement does not flap its wings with a full stroke. No important exhibitions, no *Salon*, no competitions. Let me hope that if I have the honor to send you another courier the matter will be more abundant and the reading more entertaining.

M. Brincourt.

TRAP SIPHONAGE.

Washington, D. C., January 17, 1887.

To the Editors of the American Architect: —

Dear Sirs, — I see that you have published, in connection with my report, Mr. Putnam's reply thereto. When this reply was forwarded to the Museum of Hygiene, Dr. J. T. Turner, in charge, handed it over to me for examination, to see if his exceptions were well taken. The enclosed circular was my answer.

Mr. Putnam's reply was published on his own authority, no other authority being necessary, and at his own expense. Simply in the interest of fairness was it distributed with my report; he fearing the effect of my experiments on some of his manufactured articles.

As many, and I think all of Mr. Putnam's exceptions are misleading, I would like, and I think it would be right and proper, for you to publish my answer with this explanatory letter. It may be well to

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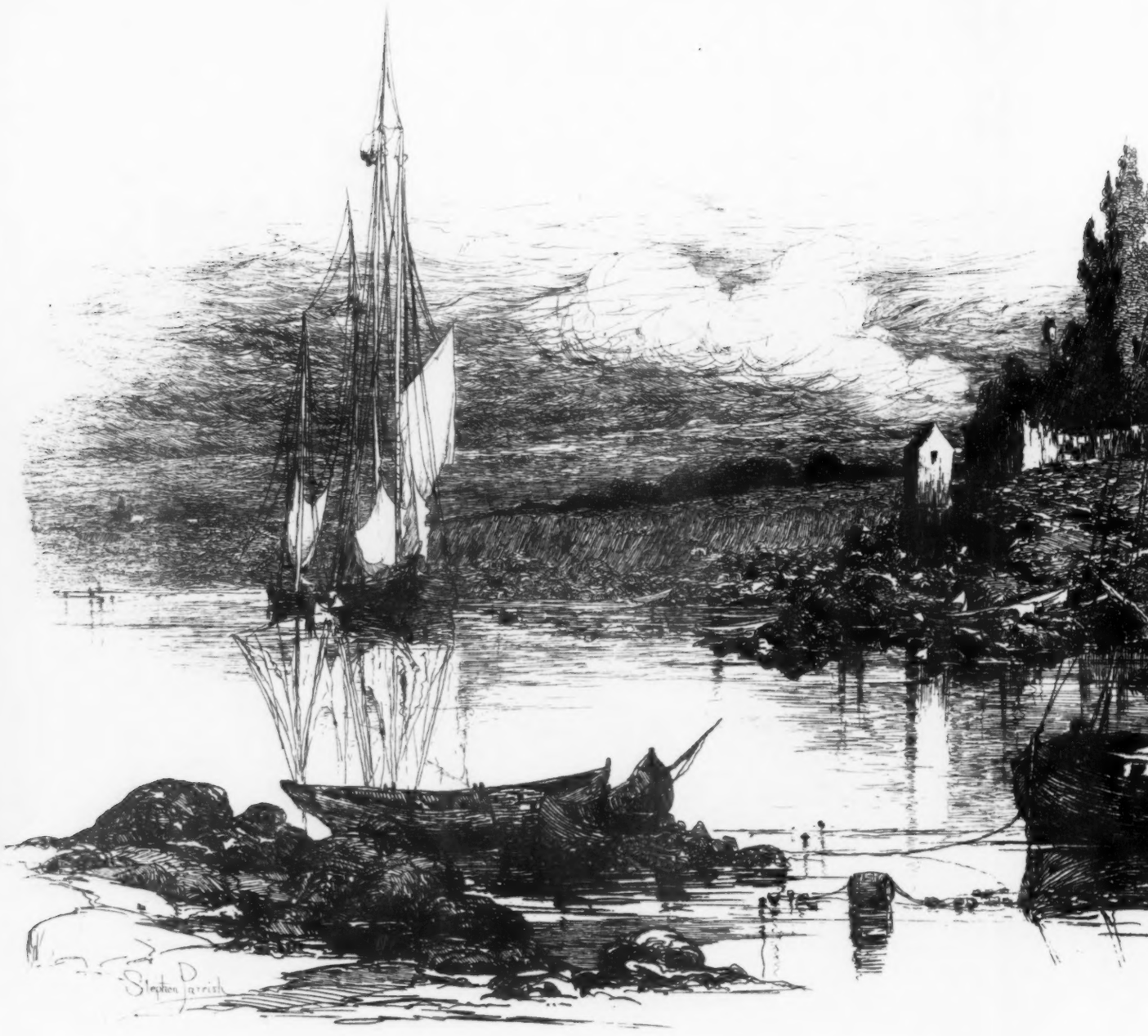

Fishermen's Houses Cape Ann.

Heliotype Printing Co Boston

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Academy of Music, Macon, Ga.

Alexander Blair. Archt.

Heliotype Printing Co Boston.

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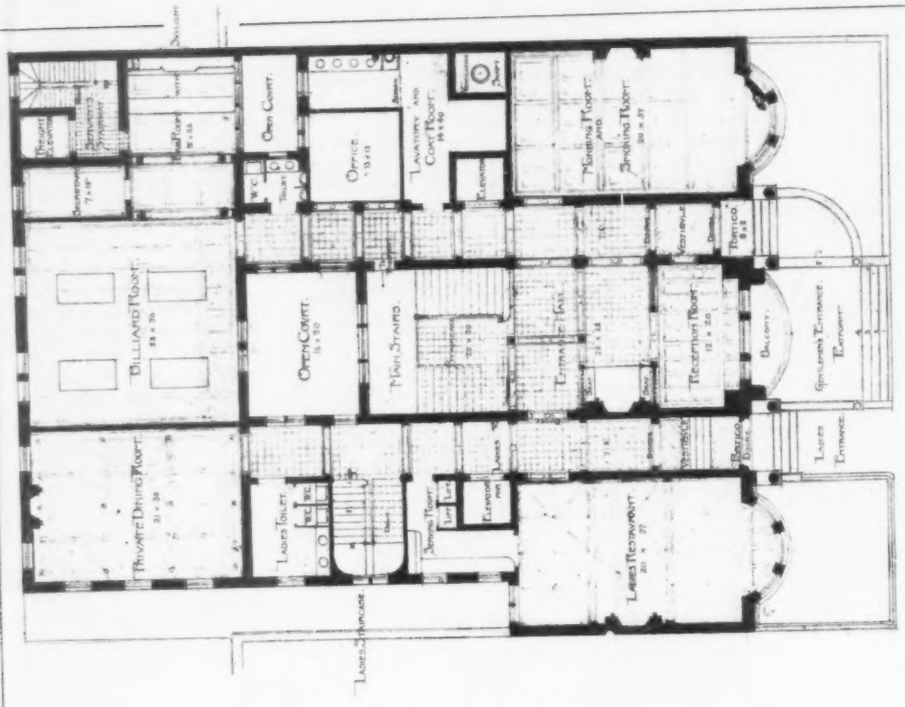
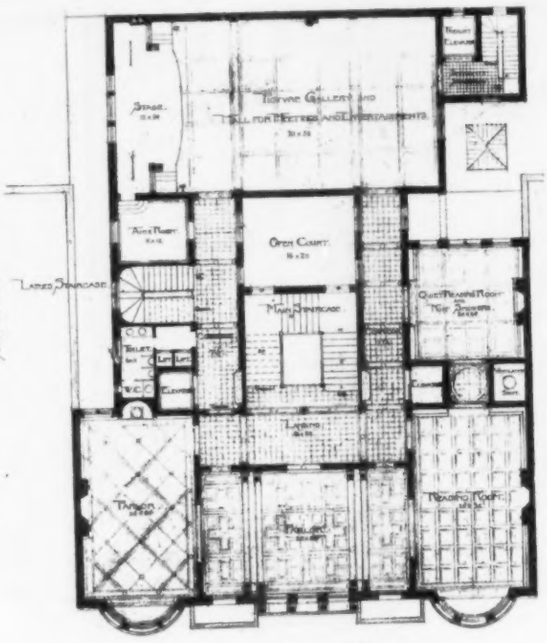




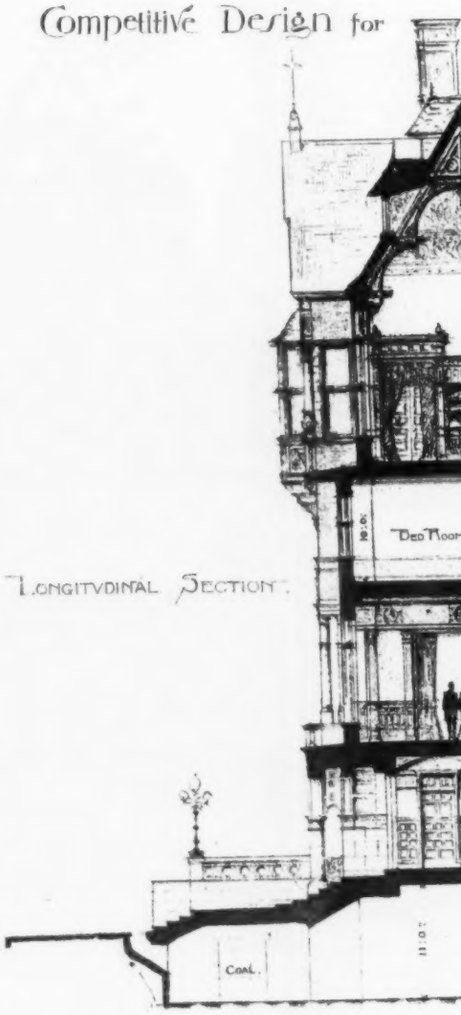
Plan of Second Story

Principal Floor.

Perspective: traced from Pencil Drawing

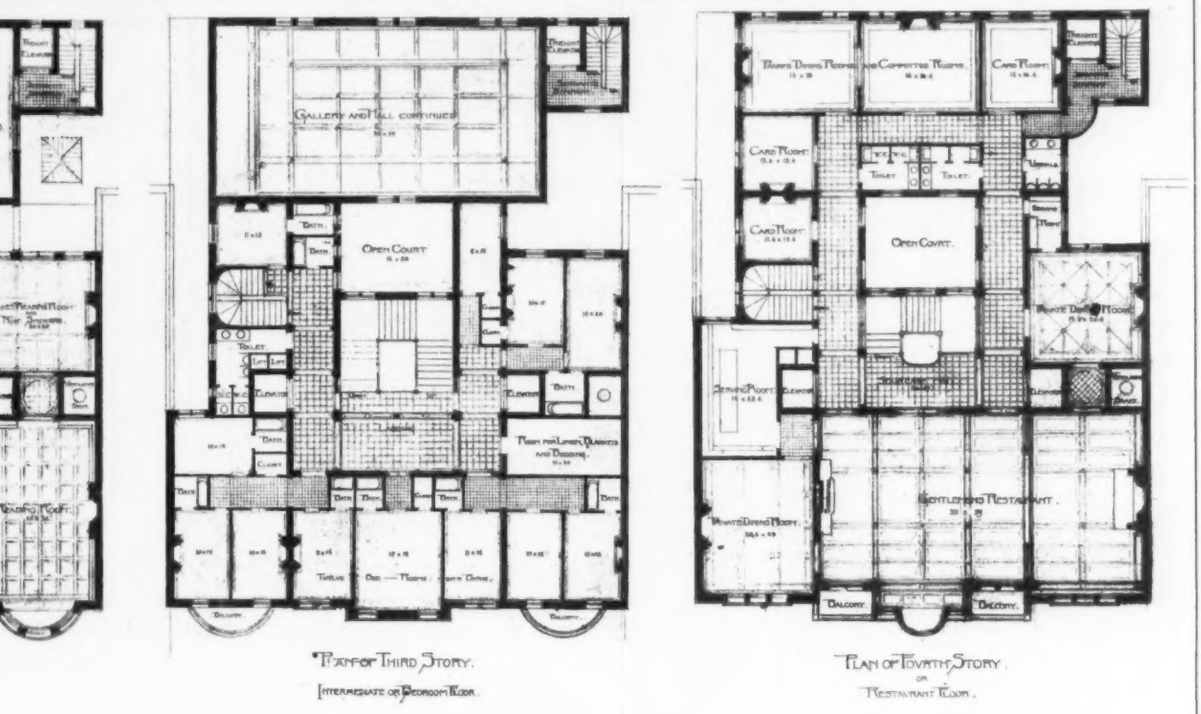
Mr. Carl. Fehmer. Archt

Competitive Design for



Longitudinal Section.

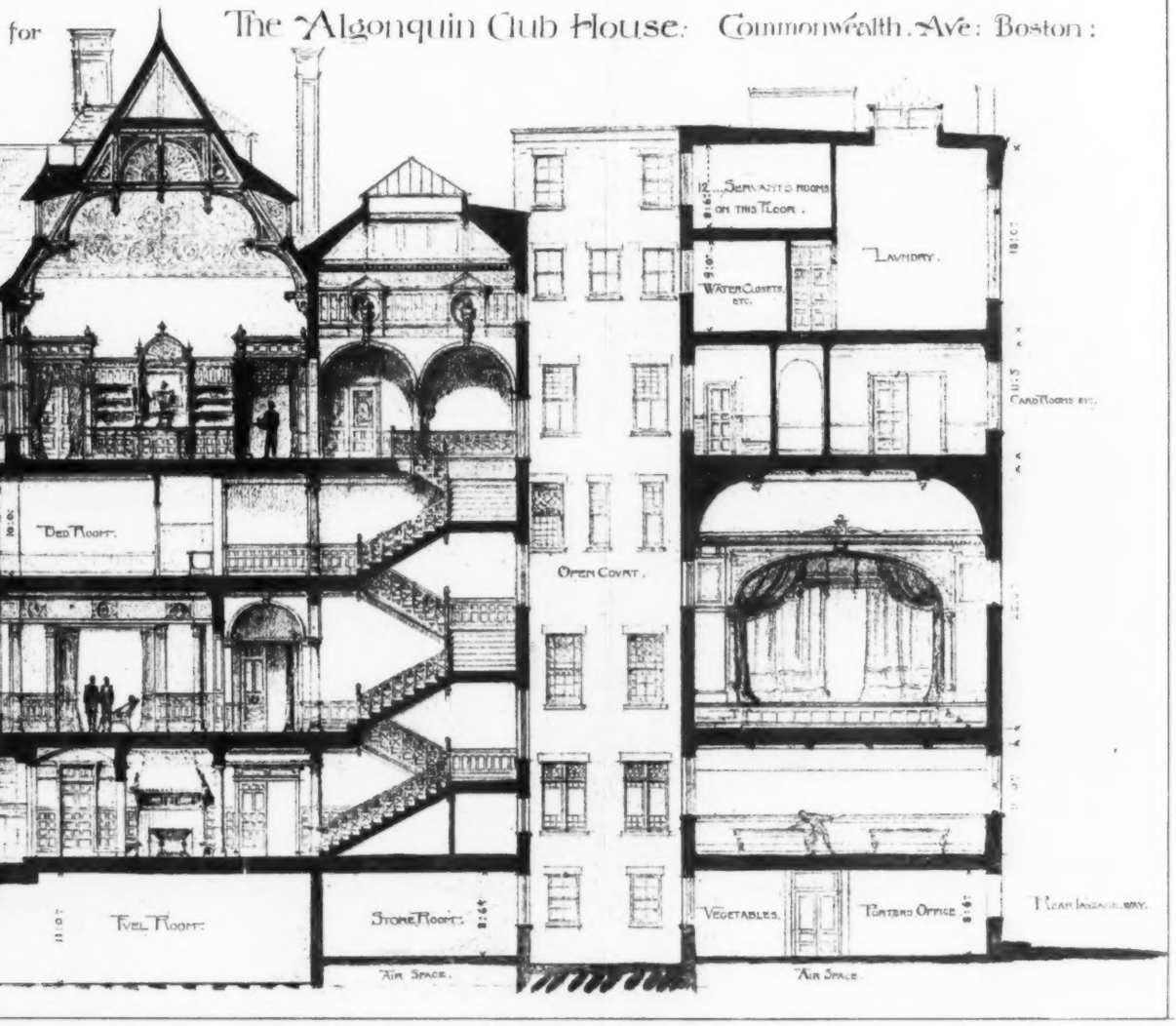
Heliotype Printing Co. Boston.



Plan of Third Story.
Intermediate or Bedroom Floor.

Plan of Fourth Story.
or
Restaurant Floor.

for The Algonquin Club House. Commonwealth Ave: Boston:



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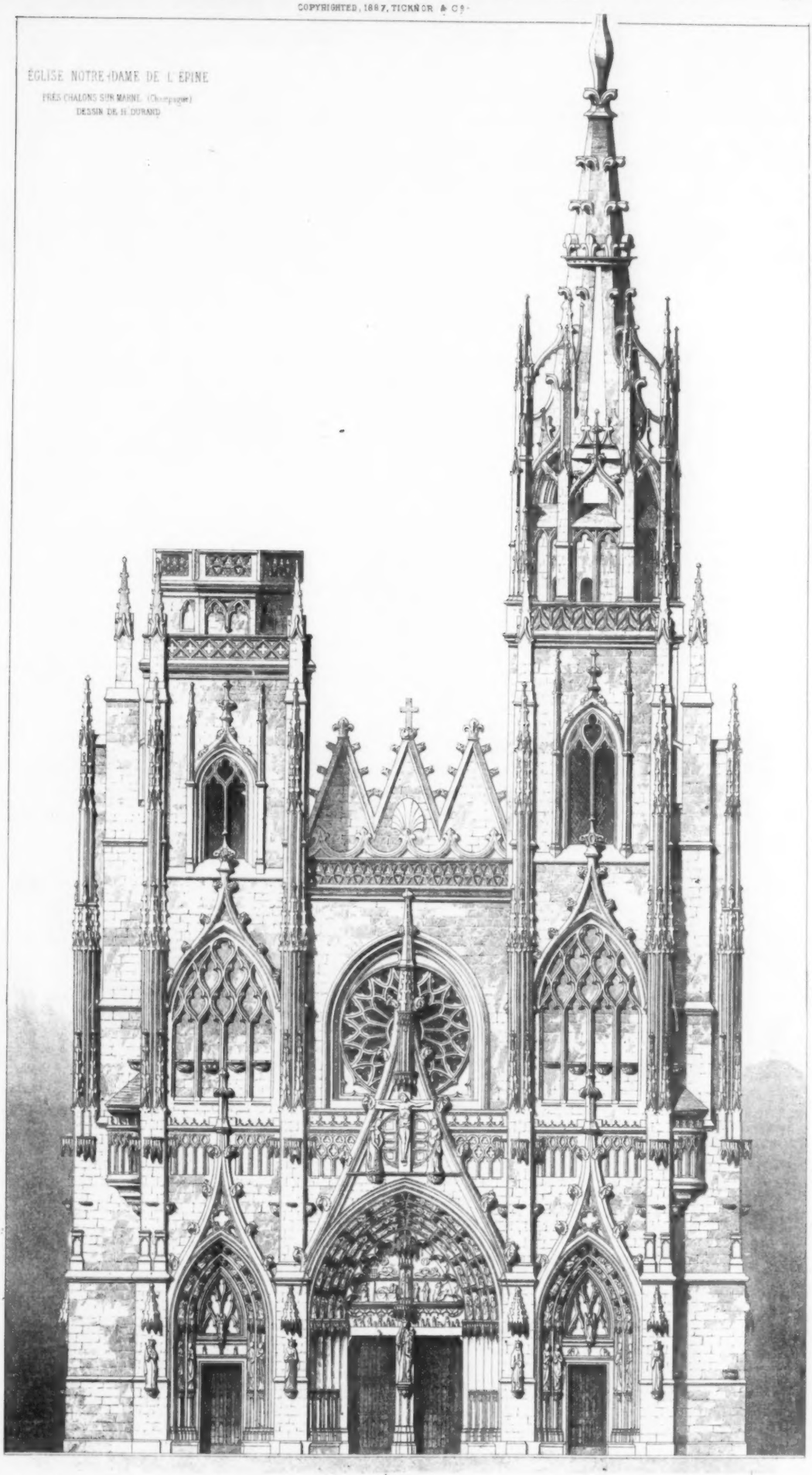
ÉGLISE NOTRE-DAME DE L'ÉPINE

PRÈS CHALONS SUR MARNE. (Champagne)

DESSIN DE H. DURAND



Heliotype Printing Co. Boston.

state that I do not intend to be drawn into any further controversy in the matter, Yours truly, GLENN BROWN.

A DISSECTION OF MR. J. PICKERING PUTNAM'S REPLY.

In answer to Mr. Putnam, I think it only necessary to make a running comment on the points of exception as laid down in his reply, to show the fallacy in each.

Answer to His Introduction.

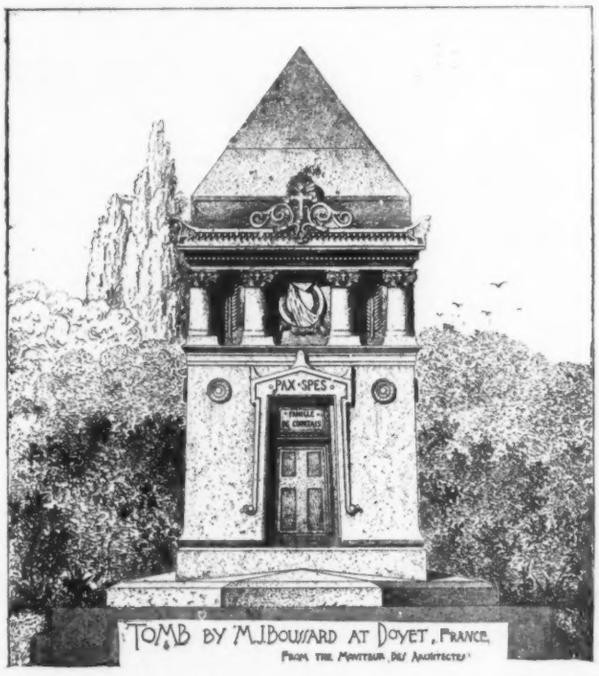
Trap ventilation does not add enormously to the expense, complication or at all to the defectiveness of plumbing. The apparatus at the Museum is arranged more nearly in accordance with the methods in ordinary use then has been the case in other experimental plants. The *Sanitary Engineer*, the best authority, says editorially in reference to the experiments, apparatus and conclusions, "that they were evidently conducted to get at the real facts, no unusual conditions were arranged, and no misleading conclusions were drawn."

Answer to Points in Mr. Putnam's Pamphlet.

(1) I agree that I have striven after the truth, and feel confident that I have obtained it in the conclusions drawn. Having no commercial interest to serve, I have endeavored to treat all alike.

(2) The vents, the area of which was varied from 0 to 3 inches, and the length from 3 to 42 feet, cover every contingency in practice. It was not intended to adhere strictly to scale in the drawings, as all the sizes of pipes and traps were printed in the Report, such a small scale being an approximation at the best.

(3) The vent-pipe used and as shown in drawing of my report, runs first horizontally 6 feet, thence vertically 29 feet, thence horizontally 7 feet, thence vertically about 2 feet, very much as shown in Mr. Putnam's cut on the right hand (Fig. 2) as an example of actual work. His cut is misleading, showing vent as being cut off at tank, he having inadvertently omitted my plan.



(4) Same answer as No. 2.

(5) I have found the S-trap when properly vented retains its seal against back-pressure and siphonage when no trap without ventilation would.

(6) I have found that sewer air is driven into the house by back-pressure from friction in the pipes and that no special bend can be located as the point of such friction. The sides of a straight pipe seem to cause all the friction that is required for such back-pressure. If the assumed objectionable bend should be located and the waste attached below the bend, in some cases, if not most cases, the waste-pipe would approximate the length of the soil-pipe. For instance, wash-basin in third story, assumed frictional bend near the fresh-air inlet outside the house, the waste-pipe would necessarily run through three stories and cellar. Back-pressure of this character does not force the water up as a mass into the pipe between the fixture and trap, but the sewer air is forced through the seal in the form of bubbles, as I have stated in my experiments. No matter how far below the fixture a trap was placed, the sewer air would be forced through the trap. This distance is shown in Mr. Putnam's Figure 2 in its most favorable light, yet what a needlessly long waste, and what a space between wash-basin and trap to become foul.

(7) My experiment shows that there is a minimum point beyond which vents should never be reduced.

(8) The lead pipe collapsed only when the roof outlet was closed. A few tests only were made under these conditions. I am afraid that the inference drawn from this point would be that all the tests were made under similar severe strains, although, of course, it was not the writer, Mr. Putnam's, intention to convey such an erroneous impression.

(9) The experiments show that when the vent is simply closed, S-traps as well as all others are siphoned because there is no vent. The Sanitas trap likewise siphons when the top of the soil-pipe is closed.

(10) Clogging of vents as well as the methods of placing them to prevent clogging are mentioned in my experiments.

(11) The top of soil-pipe when open has the same relation to the tank as the overflow would have to a fixture. This was open in a larger number of the experiments tried. Mr. Putnam's readers might here again take the erroneous impression from his text, that this severe test was applied in every case.

(12) Traps fill from the ordinary waste water in the fixtures when siphoned from the discharge in the fixture above the trap; in that case the trap being emptied only to the line of the seal.

(13) This question goes outside of my report, but I have made experiments which show the time taken to break the seal of a trap by ordinary evaporation is so great that practically it need not be considered.

(14) This is so only in a limited degree. I find Mr. Putnam's trap (the Sanitas) better than the other unvented traps in regard to siphon action, but it is more easily effected by back-pressure than the ball-traps. I consider Mr. Putnam in error as to his trap being more severely treated than the vented S-trap.

Comments on Mr. Putnam's Conclusions.

(1) I see no reason to change my deduction that properly vented traps are safe against siphonage and back-pressure.

(2) I find the seal of anti-siphon traps, Mr. Putnam's included, are not anti-siphon under all contingencies, and that they do not withstand back-pressure.

(3) The necessary expense in protecting the seal of traps by ventilation is not only justifiable but expedient.

(4) I only see one practical way of preventing back-pressure; that is by ventilation.

(5) From my experiments, and further, from this discussion, I conclude that vents of the proper size should be required by law.

After careful survey of the subject, I can see no need of further experimentation on the points under discussion, and consider the deductions as drawn up in my report as firmly established by the experiments at the Museum of Hygiene.

I do not consider trap-vent laws as perfect as the writer seems to assume in several instances. Mr. Putnam was not authorized to state or imply my assent to any of his propositions.

Yours respectfully,
GLENN BROWN.

TO DR. T. J. TURNER, DIRECTOR U. S. N.,
Bureau Medicine and Surgery, Washington, D. C.

REPLY TO MR. BROWN'S "DISSECTION."

THAT a writer should be allowed to publish, uncorrected, very serious errors in matters of fact upon which some of the most important questions in sanitary plumbing are hinged, in Reports to Government Officials at the Museum of Hygiene, based on apparatus erected in part at the Government's expense, and that these errors should be reprinted uncorrected in the leading sanitary and engineering periodicals of the country, shows a very lamentable state of affairs, and promises that, for some time longer at least, our plumbing laws are quite as likely to be founded upon illusions as upon facts.

In matters so directly affecting the health and welfare of the entire public, why should so much uncertainty and ignorance be allowed to exist? Why should the investigations and practical experiments be left to private individuals? A small proportion of the money spent by the public in complying with burdensome and unnecessary exactions in the plumbing laws, would pay for a series of scientific experiments which would definitely settle these disputed points and remove unsound theories and the objectionable features in the laws which are based upon them. If it is thought unnecessary to erect new apparatus for making these experiments, why should not the apparatus already erected by private enterprise be employed for experiment by some commission at once competent and disinterested, appointed either by Government or, as has been wisely suggested, by the *American Architect*, by scientific bodies interested in the subject and in the public welfare?

The apparatus used by myself for such experiments could undoubtedly be availed of, and would, I am certain, be found to be suitable to yield a positive and satisfactory answer to all the important questions at issue. I refer to the apparatus used in the experiments for the Boston City Board of Health, which was erected not for these tests alone, but for actual plumbing service in the building, and which was representative of the average plumbing work built in the better class of houses to-day.

The apparatus erected at the Museum of Hygiene, on the contrary, was not representative of practice, and was built outside of the building in the open air, exposed to the elements. Hence tests on

this apparatus, especially to investigate the question of evaporation, would evidently be totally unreliable. Moreover, the size and arrangement of piping was altogether unusual, and the apparatus employed for producing siphonage was such as would never be found in plumbing practice.

Most prominent among the errors committed by Mr. Brown in common with others who jump at conclusions in this field without great caution and thorough study, are his assertions regarding back-pressure and evaporation. In general, he attaches great importance to the first, notwithstanding the fact that our modern improvements in sewer and soil-pipe ventilation have really deprived it of its power for mischief, while he quite ignores the latter, which our modern trap-vent laws have rendered a really formidable source of danger.

We will take, for illustration, the sixth clause in Mr. Brown's "Dissection," which reads thus: "I have found that sewer-air is driven into the house by back-pressure from friction in the pipes, and that no special bend can be located as the point of such friction. The sides of a straight pipe seem to cause all the friction that is required for such back-pressure."

This statement is altogether at variance with the facts. It would have been easy for its author to have learned the contrary either from simple calculation, from direct experiment, or from what has already been published on this subject.

The sides of a straight pipe do *not* cause the friction required for back-pressure. To satisfy ourself of this without calculation or reasoning, it would only be necessary for one to remove the bend and trap, the true and only cause of back-pressure at the Museum of Hygiene, and repeat the test on the straight pipe without them, it would then be found that the water in the traps would in no way be affected by back-pressure, even under the severest tests applied. Any one familiar with the principles of hydraulics and pneumatics would have known this, and practical experiment here might seem superfluous. Nevertheless, the experiment has been made on the apparatus used by me, which is shown in the annexed cut. The first experiments on back-pressure were made with a double bend at the foot of the perpendicular run of soil-pipe connecting it with the horizontal iron drain in the cellar. Unusually severe strains were brought to bear upon the trap-seals in some of the experiments in order to produce the strongest possible back-pressure.

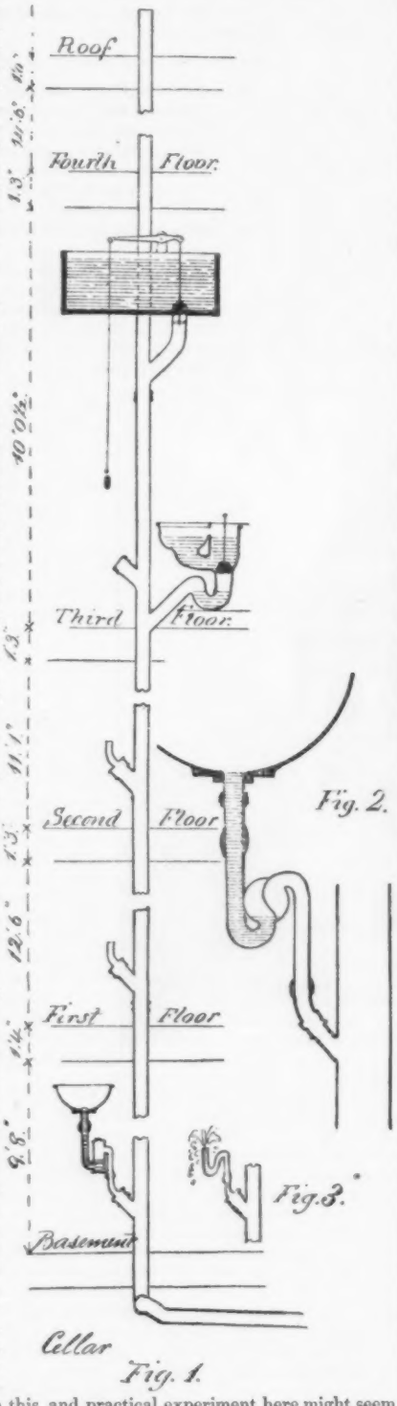


Fig. 1.

Fig. 2.

Fig. 3.

For this purpose a tank with four-inch plug-outlet therein, similar to the arrangement employed at the Museum of Hygiene was used in the third story. The strains were severe enough to siphon out clean an S-trap fully vented at the crown with a one-and-one-quarter inch vent-pipe ten feet long.

It was found that a powerful back-pressure was produced by the falling-water piston at the lowest branch-outlet in the basement just above the bend. On the first floor the back-pressure was light and on the second floor it was still more feeble, and would produce no injurious effect whatever on trap-seals however placed. In all cases this pressure could easily be resisted and the entrance of air-bubbles from the soil-pipe entirely prevented by a column of water in the trap from twelve to sixteen inches high, measuring, from the top of the fixture outlet to the bottom of the trap-seal. The back-pressure decreased rapidly as the branch receded from the bend at the bottom of the soil-pipe.

This bend was now removed leaving the lower end of the soil-pipe open, and the experiments were repeated, all the conditions otherwise being the same.

At no part of the pipe could the slightest trace of back-pressure on trap-seals connected with any of the branches be perceived. Not the slightest movement or vibration due to back-pressure was developed. But every S-trap seal, though fully vented, was instantly destroyed by siphonage after the current had passed the mouth of the branch, showing the severity of the trials. Experiments for back-pressure were made under a great variety of conditions producing strains of every degree of force. These have already been described in our Report to the Boston City Board of Health, and need not be repeated in detail here.

All our experiments showed, first, that back-pressure is caused by some sudden bend or obstruction in the pipe, and never by mere friction along its sides; second, that back-pressure strong enough to require any special provision to guard against it in plumbing practice could only be developed close to such bend or obstruction; third, that the "Sanitas" trap, or any trap holding a body of water sufficient to fill a pipe between the outlet of the fixture and the bottom of the trap-seal, and placed far enough below the fixture to give this pipe, from the top of outlet to the bottom of the trap-seal, a length of from twelve to sixteen inches, would be capable of resisting the severest back-pressure that could ever be encountered in good plumbing. To give this length of pipe would only require a trap to be set three or four inches, at the outside, lower than is now generally customary. Indeed it would be impossible to set most traps much higher than this on account of their form and of the arrangement of the fixture outlet couplings. Pot and round traps are usually set as low as the floor boards; finally, fourth, that no bubbles from the soil-pipe could ever be driven by back-pressure through the seal of a trap so formed and placed, for it is evident that no air can be forced through so long as the dip of the trap remains covered with water, as shown in Figure 2. A trap formed and set as shown in Figure 3, on the contrary, would permit air-bubbles to be pressed through it.

All this is self-evident to any one familiar with the movement of fluids in traps.

Mr. Brown makes the assertion that "The Sanitas trap likewise siphons when the top of the soil-pipe is closed." A plumber's trap is "siphoned" when its seal is destroyed by siphonage in *plumbing work*, not when it is pumped out by a force-pump nor exhausted by apparatus never encountered in plumbing.

The "Sanitas" trap has never been siphoned in plumbing work, and the implication that it has has no foundation, in fact.

The other paragraphs in Mr. Brown's "Dissection" have been sufficiently met in my reply to his original report, and need no further consideration. Respectfully yours,

J. Pickering Putnam.

[As one of the parties to this discussion has signified above his intention of saying nothing more on the subject, it is, perhaps, hardly worth while to say that we do not care to have it continued in our columns, since, unfortunately, the statements and deductions of individuals are always open to the accusation that they are influenced by unjustifiable personal bias or positively interested motives. If this question, and many others of great importance connected with sanitation in which the public is interested, is ever to be settled, it can only be through the unchallengable action of a public commission appointed by public authority, and if ever such a commission is entrusted with the work its membership must include not only sanitary experts, but master-plumbers, architects and physicians. We will take part in the present discussion only so far as to point out that while siphonage of traps is a very real danger since it leaves a free passage into the house for the foul gases of drains and sewers, back-pressure is a very unreal danger, that is, it is limited in extent and infrequent in action. It must be very rarely indeed that back-pressure is so violent as to eject the water not only from a trap but wholly out of a fixture and onto the floor, the only action that would leave the trap unsealed and a free connection between room and drain. As to paying serious attention to the forcing of a few air-bubbles through a trap-seal by back-pressure it seems to us rather absurd; for even if the results of Dr. Carmichael's experiments, which proved the innocuous qualities of sewer gases that had passed through a trap-seal, have been disproved — and we cannot remember that they have — we have the practical evidence before us of the very real existence of a class of working plumbers, who in the course of a year must breath more undiluted sewer gas than reaches the interior of a house in a lifetime, after being strained through water-seals by back-pressure. — Eds. American Architect.]

Fire and Water tells of a workman in Paterson, N. J., at work at the top of an iron smoke-stack, who was so lucky when the stack fell as to tumble into it feet foremost, and slide to the bottom. Friction and atmospheric pressure together with the inclination of the falling tube allowed him to reach the bottom comparatively unhurt.

THE REMOVAL AND DESTRUCTION OF ORGANIC WASTES.

FROM REVOIL'S ARCHITECTURE ROMANE.

THE problem of removing and of putting beyond the power to do harm — that is, of destroying — organic wastes is a large one, and one which has been taken up almost *de novo* during the active life of men who are still active in the work. It is not to be wondered at that the appalling magnitude of this problem has caused it to be regarded as an intricate and difficult one. Efforts toward its solution had to be made with the means at hand, and under the guidance of men who, however learned, had no precedent to guide them and no positive indication on which to base their theories. Much of the early work was crude work, and all that has been done has stamped itself on professional tradition to a degree that has sometimes given great impetus to false starts.

As we now understand it, the problem, great though it is and difficult though it is, is not an intricate one. It is by no means to be understood that we have reached its best nor its complete solution. It does seem clear, however, that we now know enough of its factors to apply ourselves much more intelligently than our predecessors could do, to its practical solution.

Among the traditions that have become most firmly fixed in the popular mind is the one which is indicated by the technical word "conservancy." For a long time it was believed that the most effective means of relief lay in the improvement of methods for storing refuse matters. Paris, which not many years ago believed itself to have the best sanitary system in the world, and which is still mainly dependent on that system, established regulations which are still enforced, and enforced with much success, providing for the storing up on the premises where they are produced, of all of the worst parts of personal and household waste. To-day, save where certain costly and not very good alternatives are adopted, every householder is required to provide a vast subterranean vault of prescribed dimensions, tightly cemented and practically unventilated, in which all water-closet and kindred matters must be stored, these great receptacles being emptied, sometimes by pneumatic processes and sometimes otherwise, only as they become filled. Practically, the whole city is to-day reeking with festering accumulations of the worst forms of organic wastes, producing conditions which give it a sick-rate and a death-rate far beyond anything that is known in this country — typhoid fever being always fatally present.

Even before anything like positive knowledge on the subject had been developed intelligent sanitarians had come, by instinct or by accident, to the idea that the whole principle of conservancy is radically wrong. This idea has been reinforced and established by the light thrown upon the subject by biological investigation. We are beginning to divest ourselves completely of all our former notions, and to adopt a simpler and far more rational way of treating the whole question. It is now a generally-accepted idea that relief from the evils against which we have so long contended is to be sought by the complete removal and the absolute destruction of all organic matter which can no longer be useful to human life. The means of removal, it is the office of the engineer to provide. The means of destruction, a necessary sequel and complement of the engineer's work, are to be regulated according to what we know of the almost universal processes by which nature breaks up the combinations of organized matter, and prepares its elements to enter again upon the unceasing cycle of nutrition and activity and subsequent death and dissolution.

In this destruction of the organic character we are dependent, almost, if not quite entirely, upon the development of minute organisms, of which the *bacterium termo* is the type, and apparently the master. This is the bacterium of ordinary putrefaction, active everywhere in the world wherever dead organic matter is exposed to contact with the air at ordinary temperatures. Much of our refuse, before becoming subject to bacterial action, is made to serve the uses of other organisms. It may become food for fishes or for insects, but sooner or later it all falls a prey to those microscopic organisms whose means of life and whose reason for being is to break down the last vestige of organic character.

Making due allowance for what is used to nourish higher orders of life, we find our main problem now reduced to the comparatively simple one of bringing our waste matters, as rapidly and as inoffensively as possible, into such a condition and with such surroundings that they may become subject to putrefaction and similar processes of decomposition. The experience of Tyndall, Koch, Pasteur, Sternberg and other investigators has shown that organic matter of whatever kind, shielded from the access of the organisms of which bacteria are a type, or so protected against the access of air that these bacteria cannot develop in them, will withstand putrefaction for an indefinite time. Sterilized solutions rich in organic matter remain clear so long as the infection can be withheld. Organic wastes, deeply embedded in compact wet clay, are preserved indefinitely, but the moment we admit air and subject them to infection by a single floating spore of a destructive organism, that moment their process of dissolution is begun, and the stability of their organic character is doomed.

To apply the illustration to the more tangible matters with which we have to deal, as, for example, to the outflow of a city sewer, we see that so long as it is prevented from contact with oxygen in the atmosphere or in the contained air of water-courses or of the sea, so long does it remain waste organic matter, capable of developing hurtful and dangerous qualities. Once subjected to active decomposition, it seems to yield rapidly to the natural influence and to be resolved into its elements. Therefore, the ultimate solution of the question seems to lie in putrefaction and nitrification. Its safe solution lies in such regulation of its putrefaction, in kind and in locality, that it can no longer do us harm.

Based on the conditions suggested, the more enlightened sanitarians of the world are in accord in believing that the only sure and safe way out of our difficulty lies in the complete removal of all manner of organic wastes away from the neighborhood of habitations, and its disposal under such circumstances as will lead to its rapid decomposition. The cardinal rule should be that every organic substance of whatever sort, when its usefulness has passed and when its stability is threatened, should be immediately and completely removed to a distance. Being so removed, the safety of the household or community by which it was produced is essentially assured. Its subsequent history is interesting chiefly with reference to those into whose presence we may have sent it. Their safety is to be secured by insuring its destruction under conditions which will not favor the pernicious results attendant on restricted and aborted decomposition.

It seems prudent to predict that the world will before long accept what now seems to be the demonstrated proposition, that all that we need consider with regard to the organic wastes of municipal life — the drainage from houses, the wastes of slaughtering establishments, the organic outflow of factories, etc., — to prevent their interference with the health and life of the community, is to get them out of our neighborhood while still in their fresh condition, and then to secure their rapid resolution into their organic elements.

Briefly, *speedy and complete removal with speedy and complete decomposition*, is the formula by which all our work should be guided.

It is simple and easy to say this, but it is neither simple nor easy to secure the application of such a formula in its entirety to the wastes of a community or even of a single house. Nearly everything connected with the question is subject to the influence of prejudices and preconceived ideas, to such a degree that a simple statement of all that is really effective is regarded as hypothetical, and suggestions for improvement are met at every turn by fears and doubts based upon conditions attaching to the old conservancy system. For instance, it would probably be very difficult to make the authorities of the City of Baltimore understand practically — they pretend to understand it theoretically — the vital importance of getting rid of every deposit of such matters within the limits of the city forthwith and permanently. Those authorities would probably accept as a good compromise a system by which privy-vaults and cesspools should be made absolutely tight, and should be emptied by pneumatic process once a month; although, if they examined the matter critically, they would doubtless realize that within a week the accumulated mass would be in active fermentation, and that that condition would extend itself promptly to all of the fresh matters which are being constantly added to the mass. They would probably consider it a subject of congratulation if the whole city could be, without cost, provided with large brick sewers built after the Paris and London plan, for the partial removal and the complete concealment of what was sent into them; though, if they examined the matter critically, they would realize the truth of the old expression with regard to such sewers that they are little better than "elongated cesspools," not, it is true, filled with deposits, but retaining such an amount of deposit and maintaining such a state of decomposition as to produce all the pernicious aeriform results which we recognize in the case of the cesspool.

Were a system of complete, quick, and cleanly removal submitted to them for an opinion, and were it one feature of the project that the sewers of the system should be ventilated by untrapped drains and soil-pipes, more than one of them would at once object to the admission of "sewer-gas" into pipes which pass through houses; though on examining the subject critically they would see that under such a system, sewer-gas, which is a product solely of the putrefaction of retained organic matter, cannot exist where all is promptly removed.

This topic is a very far-reaching one, and the short time at our disposal will not suffice even for its casual examination. The most that can be hoped for is that the cardinal principle involved may be so suggested as to lead to further and useful consideration and study. Let us, therefore, sketch hastily the works that might be proposed for the drainage we will say of a town of 10,000 inhabitants, sloping toward a natural valley running through it, and having a general and sufficient fall through and beyond it in the direction toward which the valley trends. For simplicity, we will disregard the treatment of storm-water, which, as the town has grown, is quite sure to have been met in some practical and tolerably effective manner. With regard to its foul drainage, let us fancy for the moment that we have absolute power and a sufficient appropriation to treat it as we like. We will lay through every street or alley, one or the other, according to circumstances — a net-work of sewers reaching

the immediate vicinity of every house-lot, the sewers joining each other as they go on, until finally the whole are united in one main trunk-sewer passing out of the city limits at the lowest point.

The purpose of these sewers is to remove foul drainage and nothing else. The sizes may therefore be established on something like an intelligent basis. We have not to provide for occasional enormous contributions of storm-water, but only for the daily outflow of houses which use about the same amount of water day by day, and industrial establishments which produce about the same amount of waste week by week. For simplicity again, we will not consider the provision needed for an increase of population.

The characteristic element of the system would be a lateral sewer of the smallest size, running for as great a distance as that size is applicable to. For reasons which will bear investigation, let us adopt a diameter of six inches, maintaining this size until the direct sewer and the tributaries entering it aggregate a length of 2,000 feet. Making due allowance for street-crossings, unoccupied land, etc., let us assume that there is, on one side of the street or the other, and on the average one house for every 25 feet of length. This will give us an aggregate of 80 houses, with a population let us say of 600, producing a maximum daily amount of sewage equal to 30,000 gallons, or 4,000 cubic feet.

As more water is used, and more sewage discharged during the forenoon than during the afternoon, and more during the day than during the night, let us suppose that one-half, or 2,000 cubic feet, would be delivered in eight hours, 250 in one hour, or, with a margin for error, five cubic feet in a minute. A six-inch pipe laid with the least inclination suitable for such a pipe, or on a fall of 1 to 300, has a capacity of discharge of more than 23 cubic feet per minute, so that, so far as the accommodation of the stream is concerned, our limit of 2,000 feet length, in a closely-built area, is very well within the mark. It is not desirable, however, that the sewers should ever be taxed to anything like their full capacity; they should have ample space above the flowing sewage for ventilation, and should be large enough to transmit — without an opportunity to accumulate and form obstructions — everything that can come to them through a four-inch house-drain.

Throughout the lower portion of the sewer, 2,000 feet long, there would be at all times a considerable flow, so that whatever objects coming from houses may be delivered into it, will be swept along and carried to the outlet without forming deposits. Throughout the upper portion of the line, however, the flow will always be less, will often be slight, and will at times be practically absent. At such points, it is found by experience that solid matters delivered by house-drains in the ordinary volume of water used in discharging a water-closet, for example, will not be carried forward through the six-inch pipe. To a greater or less extent, they will be stranded by the way, and unless some special provision is made for their removal, they would in time accumulate to a degree which would produce a very objectionable seat of offensive decomposition.

To obviate this difficulty, to pick up all stranded substances and sweep them forward into the constant current, we resort to artificial flushing. We cannot trust to nature to flush our sewer properly with rain-water, because, sometimes for weeks and weeks together, nature withholds its provision. We cannot trust to hand flushing for proper efficiency, because of the difficulty of securing the regular and proper performance of such duty by ordinary town employés, and because of its inordinate cost. The best we can do is to adopt a system of frequent flushing by automatic flush-tanks, so that, without care or thought on the part of those who have charge of the work, the regular, copious daily cleansing of the whole system may be depended on.

As already suggested, the sewers, as they come together, and as their length increases, will increase in size. We may assume that for the community under consideration the main sewer as it leaves the town, having a fall of 1 to 500, will have a diameter of 15 inches. If removing only the foul wastes of such a community, this main sewer would never run half full.

The system described, so far as street sewers are concerned, will secure the absolute removal of everything delivered into them at least as frequently as the operation of the flush-tanks takes place — say once in 24 hours.

To secure the full benefit of this system, so far as the interior of the town is concerned, it should be rigidly provided that every house shall be, in all its parts, provided with appliances for drainage, constructed on the same principle of complete and constant cleanliness. Every water-closet, sink, wash-tub — everything that receives organic wastes, should at each use discharge a sufficient volume of water to secure the complete transportation of all solids all the way into the street sewer. Once delivered there, the sewer itself will take care of them, and we shall have removed from our houses as well as from our town everything which might become offensive if retained.

The system of house-drains removes it from the houses; the sewers remove it from the town, and we have now to consider the question of ultimate destruction.

The material that we have to treat is free from putrefaction; it is little more than dirty water. It contains, of course, the fæcal wastes of the population, but these are distributed through such a mass of water that they have completely lost their original offensive character. The problem, simply stated, is: to secure the complete disintegration and destruction of the organic parts.

[To be continued.]

THE EFFECT OF ADDING SACCHARINE MATTER TO MORTARS.

A LETTER from Mr. Thomson Hankey "On a New Use of Sugar" — *Times*, October 13 — has given rise to wide discussion and inquiry. At a time when the price of sugar is so low, and, as I shall show when the use of a very small quantity of it, or of treacle, adds largely to the strength of mortar, and makes Portland cement itself set with great rapidity, it seems to me that I may do a service to engineers by laying before them the scientific grounds on which I was led to experiment on the subject, and the remarkable results which have been obtained.

The practical importance of this addition of saccharine matter to mortar I will state briefly to begin with, and will give a few illustrations.

I mixed in a small jar some Portland cement and brown sugar, adding water and stirring. I took out a little of the cement for an experiment, and when I tried an hour after to take out more, I found that the remainder had already set.

My neighbor, Mr. Rowland, weighed carefully Portland cement and sand into four small jars. To two he added different sugars, to the third treacle, but to the fourth no saccharine matter. On the following day the cement had set — we do not know how much earlier, for it was not examined — in all the jars with saccharine matter. Mr. Holden, Jr., the foreman of a builder, examined all of them on the Monday following the Friday on which they had been mixed. On pressing the cement to which the treacle had been added, he said, "I might press the bottom of the jar out before I can make an impression on this." He then put his finger into the jar in which there was no saccharine matter, and stirred up the cement, which had not set at all, and which did not set till a day or two after. It may be objected that it might not be an advantage that it should set so quickly. This objection will be answered by-and-by as I proceed, by showing that it is highly probable that the strength of Portland cement will be greatly increased by this addition of saccharine matter.

Mr. Thomson Hankey had experiments made, first, by his own brickmaker, and secondly by a house-builder. Both reported that the addition of sugar made a common lime equal to Portland cement.

The bearing of these facts will be plain to every engineer, but I cannot forbear mentioning here a startling incident. The Ecclesiastical Commissioners built for the late Bishop Fraser, of Manchester, on his coming into the diocese, a lodge like that at Lambeth, with a lofty archway set in Portland cement. A clerk-of-the-works appointed by the architect of the Commissioners superintended it. After a due time the scaffolding was removed. One day — perhaps that day — the bishop walked through, and had just got beyond danger, when the whole of the archway fell. If he had been under it, he would have been killed, and his grand career as a bishop would have been cut short at the outset. Your readers, as I proceed with my statement, will judge for themselves whether the additions of a few shillingsworth of treacle would not have made all secure, and have saved the expense of doing this work over again.

I have to explain how it is that sugar, or rather saccharine matter of any kind, produces this remarkable effect on lime. Here I ought to mention that I am a retired physician, and that the idea of putting the matter to the proof arose in the following manner. In medicine we have two kinds of lime-water: one, the common lime-water that can be got by mixing lime and water. It is to be particularly noted that, add as much lime as you like, it is impossible to get water to dissolve more than half a grain of lime in one ounce, or about two small tablespoonfuls of water. But by adding two parts of white sugar to one part of lime, we obtain a solution containing about fourteen-and-one-half times more lime in the same quantity of water. Here it is to be observed — and it is a most important point — that there are hot limes, such as Buxton lime, which, if the sugar be incautiously mixed with them, will *burn* the sugar, make it a deep brown color, and convert it into other chemical forms, and possibly, and I think probably, will destroy its value in mortar. The way to use sugar with such limes is to dissolve it first in the water. I dwell particularly upon this, because a gentleman referred to me by Mr. Thomson Hankey, in writing to thank me for the information I had given him, casually observed that his cement had turned nearly black by the addition of the sugar. Probably many other experimenters with sugar and hot limes have had the same result, and are in the belief that all is right. Our strong medical saccharated lime-water looks like water.

Ten or fifteen years ago I had been experimenting with lime and sugar, but not in reference to mortar, and I spoke about that time to my friend, the late E. W. Binney, F. R. S., about this property of sugar. He said that it was very curious, and that it was new to him: and he told me this anecdote, that in his grandfather's time an Italian architect came down to Worksop to erect a building for a nobleman, and insisted on being supplied with malt to make his mortar with; the malt was supplied and used. Many years afterwards, this building had to be taken down; but, said Binney, "they could not pull it down, do what they would, and they had to use gunpowder."

I said, it would be the saccharine matter in the malt that produced this result. He agreed with me.

A few months ago I was at Peterborough, and went to see the progress of the restoration of the cathedral, where I made the acquaintance of Mr. Irvine, Mr. Pearsons's clerk-of-the-works. Mr. Irvine was for more than a quarter of a century with Sir Gilbert Scott, and possesses a greater knowledge of architecture, and antiquity bearing on English architecture, than any one I ever met with.

One day I said to him that I had been to Fotheringay. He replied that he had seen every other church than that in the neighborhood of Peterborough. I asked him to go with me on his Saturday's half-holiday, as my visit to the church had been a hurried one, and I wished to make some further inquiries. Besides, I was glad to have the companionship of one who was so thorough a master of the subject. The chancel of this fine church, built before the nave, and so late as 1410, has entirely perished; and it had been so badly built that even in the time of Queen Elizabeth it had fallen in and was then in ruins. The chancel and tower exist, but the tower is unsafe, and if the church be not soon restored, this grand historical monument may suffer or be destroyed.

As Mr. Irvine and I walked to the railway station, I asked him whether he was aware of the chemical fact that the addition of sugar to water makes it take up about sixteen times more lime than water by itself does — I might have said a little more than fourteen times. He replied that he did not know this fact, and that he had never heard of it, and that he did not believe that it had been so used in mortars. I then told him what Mr. Binney had told me regarding the building erected by the Italian architect near Worksop. He said that he had been clerk-of-the-works in the restoration of several cathedrals, in the books of which he had met with old entries of payments "For beer for the masons," and that he had found one entry where it was written, "For beer to mix with the mortar." I said that that would be for the saccharine matter in it; and, I added, that a few years ago I had seen in a newspaper that the vintage in Spain had been so abundant that the people had not casks enough, and were using the wine to mix with their mortar. It flashed across my mind that this traditional use of saccharine matter was probably the explanation of the exceptional hardness of the old Roman mortar, and had been handed down from generation to generation, and had at length been forgotten, in England at any rate.

A few days afterwards I was pondering, as I walked along the street in Peterborough, on this matter, when suddenly I said to myself, "Why not try the experiment?" I went into a grocer's shop and bought a pound of exceedingly finely powdered sugar and some beeswax — of the wax I will speak some other time. I took the sugar to the hut in the cathedral yard, where I found the foreman of the contractor and Mr. Irvine. Laughing, I said, "I have come to teach you to suck eggs." After explaining to the intelligent foreman my views, he and Mr. Irvine kindly agreed to try the experiment. Some powdered lias lime and some of the sugar were being mixed together in an iron basin. Water was added, and Mr. Irvine began to stir them with a trowel. No sooner had he done so than he exclaimed, "Look, look! It is beginning to set already." I said, "Is not that usual?" He replied, "No; something very uncommon." The mortar was poured out on the end of a beam where it set. Some more was then made much thinner, and a little sand added to it. With this, which was about the consistency of cream, two largish fragments of the broken-stone tracery of an old window were joined, and so were two bricks, two pieces of glass, and two slates. It would be about five o'clock in the evening. As I was going to leave Peterborough about noon on the following day, I called at the cathedral about ten in the morning to see the results. Mr. Irvine said it was too early to judge. He felt at the stone tracery very tenderly. Holding the upper fragment, he then tilted the tracery sideways, and as the stones held together, he then took hold of the upper fragment with both hands and lifted the whole stone without the lower fragment falling off. In like manner, in lifting both bricks, the lower brick did not fall off. The slate and the glass seemed also set. So that the experiments seemed to confirm remarkably the view I had formed, on theoretical and chemical grounds chiefly, that saccharine matter added to mortar would be of great value, and that an important discovery had been made.

I wrote to my brother-in-law, Mr. Guildford Molesworth, engineer-in-chief to the State Railways in India, and author of "*The Engineer's Pocket-Book*," telling him what we had done. From him I received a letter dated Simla, August 28, 1886, giving me the following interesting particulars: "With regard to your addition of sugar to mortar, it is a practice that has been in use in the Madras Presidency from time immemorial." The following is an extract from the Roorha (?) "*Treatise on Civil Engineering*," Vol. I, page 150, third edition: "It is common in this country to mix a small quantity of the coarsest sugar — 'goor,' or 'jaghery,' as it is termed in India — with the water used for working up mortar. Where fat limes alone can be procured, their bad qualities may to some degree be corrected by it, as its influence is very great in the first solidification of mortar. Captain Smith attributes the fact that mortars made of shell lime have stood the action of the weather for centuries, to this mixture of jaghery in their composition. He made experiments on bricks joined together by mortar consisting of one part of common shell lime to one and one-half of sand. One pound of jaghery was mixed with each gallon of water with which the mortar was mixed. The bricks were left for thirteen hours, and after that time the average breaking weight of the joints in twenty trials was six and one-half pounds per square inch. In twenty-one specimens joined with the same mortar, but without jaghery, the breaking weight was four and one-half pounds per square inch."

Mr. Molesworth then adds: "The use of sugar and jaghery was known to me when I was in Ceylon twenty years ago. The masons who came over from Madras used to made most beautiful plaster-work, almost like enamelled tiles, of shell lime mixed with jaghery. The surface took a fine polish, and was as hard as marble; but it required a good deal of patient manipulation well suited to the national character."

This intelligence from India supplies proof of the most positive kind of the enormous strengthening power of sugar when mixed with mortar. It may be argued that some of our limes and cements are of themselves good enough without it. It is for engineers to judge whether they might not be made much better by it, or whether the facts I have brought forward do not show plainly that there should be an inquiry instituted by scientific men to investigate the actual *numerical* value of sugar, and the various conditions under which it acts, whether for better or worse. For the worse it cannot act, except such an insane use of it be made by adding too much, as to expect sugar to be itself mortar. The jaghery sugar used in India is sold in the London market at, I think, less than a penny a pound, and is used for feeding cattle. Treacle seems to me to be a most promising form of saccharine matter. I would shirk beet-root sugar. There is a rough, unrefined treacle, which is very cheap, and I should suppose would be excellent. A halfpenny-worth of treacle and water added to a hod of mortar would, I conjecture, increase its strength by one-third, if not by one-half.

But I must leave the matter in the hands of scientific engineers. I think it is very probable that this use of sugar with lime is of extreme antiquity, and that a knowledge of it passed from India to Egypt and Rome, and that these nations used malt for its saccharine matter as a substitute for sugar. I have shown that the mediæval builders used beer in building our cathedrals, and beer is still used with plaster-of-Paris. These I take to be the remnants of ancient tradition. It is said that in the cold winter when Bess of Hardwicke died, her masons had to "melt the beer which they mixed with their mortar." They would have acted more wisely if they had used infusion of malt only, for most of the sugar must have been converted into alcohol, and lost for the purposes of mortar-making. Antiquarians may be able, from old documents, to throw light upon this subject; but I strongly suspect that the old Roman mortar had saccharine matter added to it, and I am of opinion that, in all engineering works requiring great strength, it would be wrong not to take advantage of facts confirmed by the experience of ages.—*The Engineer.*

THE OLD SOUTH MEETING-HOUSE, WORCESTER, MASS.

WORCESTER, January 11, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — A matter has been considerably discussed in Worcester, and is to be shortly decided, in which you may find some interest, antiquarian and architectural. This concerns the destruction or preservation of the "Old South Meeting-House." Perhaps you may see a way to help on a right decision. The City Government has taken the needed steps to acquire the title from the parish, and there remains the valuation and payment to be consummated and the fate of the old structure to be determined. At the west end of the Worcester Common stand two buildings, at northwest corner the City-hall, and a few rods south of this the old church. The body of the church within and without has been so changed as to have lost all its original features, but the belfry and steeple seem to remain as they were built, about 1760.

The spire is of no great size or beauty, but it is, I think, the only piece of colonial architecture in the city that can claim a monumental importance, and I hope that you will agree with me that it has sufficient historic and picturesque merit to demand an honorable preservation. In a letter published last spring by the *Spy* I suggested that the old spire might be mounted upon a

new stone tower of appropriate design, and that this would be excellently placed in the wide street, called Salem Square, at the east end of the common, which is of size to be used as a hay market, and at its centre has the weigher's office. Devote the ground-floor of the proposed tower to the weigher's use and a reason is given for such a location of the tower. Moreover, that site overlooks a much-travelled thoroughfare, Front Street, and the clock and bell and vane would be where they would serve many.

My idea is to make it a "Worcester tower," where historic inscriptions, bas-reliefs, and perhaps statues of local worthies might later find a fitting place. Could you not interest your readers by publishing such a "restoration" and thus give something that could put visibly before the gentlemen of the City Government and those of antiquarian tastes what it is quite possible to accomplish, with no great expenditure, retaining what is good from the past to make an honorable trophy for municipal pride? In the hope that you may find the theme acceptable I enclose a photograph of the "Old South" and of the proposed site, and an esquisse-esquisse, which, after being suitably (and very largely) improved in your office and put into perspective, I should much like to put in the hands of our aldermen, the members of the two antiquarian societies and the members of the Old South who only relinquished their property under compulsion.

Last month was the centennial of Shay's rebellion, and the newspaper recounted what a sturdy front was presented by General Ward who, as Chief Justice of the court, breasted the bayonets of the insurgents. That would make one figure for our tower. (He had been the *first* American *major-general*.) Colonel Ward, who was killed at the head of the 15th Massachusetts (the Worcester) regiment at Antietam, would make another. Is not Mr. Bancroft the most distinguished living American, and, as a native of Worcester, would not the city honor itself by placing his figure at the third corner of our tower? But, leaving the sculptor's work for the future, does not the simple stone wall, modestly covered with ivy perhaps, and surmounted by the old steeple, appeal successfully to your sympathy and help. Yours truly, H. A. Phillips.

COMMUNICATIONS

A FIRE-PROOF FLOOR.

Chicago, January 19, 1887.

To the Editors of the American Architect:—

Dear Sirs,—In response to "*Enquirer*" of Toronto I wish to say that it seems hardly advisable to use timbers for floors of a size as large as 36′ x 39′. These large spans ought to be covered with twenty-inch iron or steel beams at about five feet centres, the ceiling to consist of two-and-one-half inch fire-clay brick-tiles upon light T-irons, and the floor of either planks or four-inch brick-tiles upon four-inch light beams, levelling up with the top of the twenty-inch beams. Since twenty-inch beams are long since rolled in England and Belgium, and probably much cheaper in Canada than in the United States, and tiles, if such be not made in Canada, can be cheaply imported via Cleveland, costing there about seven cents and nine cents respectively per square foot, this construction will at once be the most solid and stiff, fairly moderate in price and not only slow-burning, but strictly fire-proof. Instead of arranging a flat ceiling the beams can be shown and covered with tile and ornamental plastering to suit any design. Yours truly, Carl Seiffert.

NOTES AND CLIPPINGS

The Trade-unions of England.—By order of the House of Commons Messrs. Hansard have just printed an appendix to the returns of the Chief Registrar of Friendly Societies for the year ending December 31, 1885, giving a list of registered trade-unions in the United Kingdom, with the dates of their establishment, and, in some cases, particulars of their funds, incomes, and membership. From this it appears that the oldest of all the trade-unions in the kingdom is the Steam-engine Makers' Society, Manchester, which was established on November 2, 1824, and has now £10,435 accumulated funds, an annual income of £11,336, and a membership of 5,062. The union possessing the largest fund of those which have sent in returns (though it must be remembered that several of the largest societies, such, for example, as the Amalgamated Society of Engineers, have given no particulars of their finances) is the Amalgamated Society of Carpenters and Joiners, with headquarters at Manchester. The funds of this organization are stated at £50,851; annual income £63,122; and membership 25,781: it is, however, closely pressed by the Amalgamated Society of Railway Servants of England, Ireland, Scotland and Wales, whose headquarters are in City Road, London. The funds of this society are stated at £50,789, with an annual income of £14,375 and 9,054 members. The largest annual income—£70,704—is claimed by the United Society of Boiler-makers and Iron Ship-builders of Newcastle-on-Tyne, with 27,695 members and accumulated funds amounting to £38,317. The Durham Miners' Association appears to be, so far as the returns show, numerically the strongest union in the kingdom, having 35,000 members, with an income of £46,153, and funds amounting to £35,993. Some of the titles of these societies show the extensive ramifications of trades-unionism. That there is a Warehousemen's Philanthropic Society in Bradford should occasion no surprise, but the same town boasts of a Stuff-makers-up Provident Society with considerable funds, and an income of more than £1,000 a year. The card-setting machine tenters, drillers and cutters of the "River Wear," Dutch yeast importers, trimmers and teemers, crabbers and singers, silk-ballers, potters' mould-makers, boot-top cutters, hammermen, tin-canister makers, carriage-straighteners, tape-sizers, chippers and drillers, brass-cock finishers, the amalgamated chimney-sweeps, the amicable wool-staplers, and the rundlet coopers—all these and many more have separate trade organizations of their own for mutual protection. Women, too, have learned the utility of combination, as may be gathered from the titles of the Westminster and Pimlico Branch of the London Tailoresses Trade-union, and the Rochdale Male and Female Card and Blowing-room Operatives' Association. In Sunderland there is a Shipyard Helpers' Association, and Birkenhead possesses the distinction of being the headquarters of the United Society of Holders-up of Great Britain and Ireland, which has 317 members, an annual income of £355, and £275 funded.—*London Standard*.

TRADE SURVEYS

Financiers who have been obliged for a few years past to put up with legitimate investments and margins, are just now, between midwinter and spring, watching the course of every channel of trade with unusual interest. Of all men, they have the least to say, but they are the closest observers. They are measuring possibilities. The facts and tendencies before them may be summarized as follows: There is an enormous absorption of capital in railroad construction, in manufactures and in house-construction companies. Firms and corporations are springing up by the hundred, investing what ready cash they can command and borrowing in many cases. Enterprise has been let loose, and production is being expanded, and capacity enlarged, and facilities of every kind multiplied. The opportunities for capital are being taken advantage of everywhere. Profits are sure though not so great as to attract it too freely. Money has been and is cheap, but how long, asks the financier, will it continue so. Are not the business interests of the country becoming heavily indebted to the money-lenders? Will not money soon be worth double its present rate? Will not this great absorption of capital increase its value and hence demand? Can we continue to invest $250,000,000 a year in railroad building, and more than as much more in house and shop building, to say nothing of the enormous sums in the endless outlays in other directions without discovering an inequality between the supply of and demand for money? And, when money becomes scarce and interest high will not values decline and property depreciate? Cannot all the financiers see the drift of things and be ready when the storm comes to buy up for a song the accumulations of industry for a decade? They are asking themselves these questions and counting probabilities. It is, therefore, well for those who are to suffer when these results happen, to give heed to the inquiry. Is there any immediate danger, immediate within one or two years? So far, not the least calculation has been made for a storm. Nor could it be expected of a people that they should do so when beset with demand for the products of forge, loom, and reaper, with an urgency seldom witnessed; nor yet should there be any occasion for care with the world half fed. The relations between a larger or smaller volume of money as distinguished from capital and the greater or lesser prosperity of a people have never been satisfactorily established, but the money-lending interests recognize that, at the present rate of absorption they will have, in the not remote future, a chance to accumulate rapidly. Yet the financiers may this time reckon without their host, the people and their energy and inventiveness of means to escape threatened ills. The plain facts are—business is rapidly expanding, and that the probable extensions and new constructions will surpass all former experiences. If the country is not wise enough to recognize and, at the proper time, apply the proper remedies and safe-guards, then, as individuals, we must suffer in common with all others. Fortunately, however, there are a few little indications that a conservative feeling is gaining control in trade. Where extremely high prices have been asked buyers have retired from the market. Where reasonable advances have been made buyers have liberally purchased. The great bulk of business now in hands of manufacturers of all kinds is covered by contracts of raw material. The railroad-builders have 1,200,000 miles of rails bought. The railway managers have orders out for locomotive-cars, etc. Mill owners have requirements covered all along the line down to the shopmen. Hence the danger of an overpowering demand has been greatly reduced. The downward tendency in agricultural products and the upward tendency in manufactured products must soon equalize themselves. Stocks are active in all markets because speculation on a large scale is impossible under our well-organized industrial system. The inducements to extend manufacturing are strong enough to guarantee us against idle capital or enterprise. Yet, at our present progress the stringency must come unless checked by conservative action of producers and transporters.

Within a few days buyers have disappeared from several markets on account of high prices. Large consuming interests are waiting, hoping to purchase at November or December prices. In lumber, coal, textiles, hardware, the spring prices will be very little different from last autumn's prices. In other directions there will be differences of 10 to 25 per cent. The nail-makers have regained control of the market. The Eastern bar-iron makers find their last week's advance easily maintained. The anthracite-coal producers have renewed this understanding, and the bituminous interests have formed a pool and fixed percentages. Demand is active both East and West. In building material prices remain steady. Lumber will decline in Atlantic markets by the opening of spring. Nails will also likely weaken, although manufacturers predict a further advance. Machinery building will engage more labor as the season progresses. The architects in Eastern cities are becoming quite busy on spring work, and in Western cities encouraging expectations are entertained as to the coming year's work. The tool-makers and the leaders in a multitude of small industries employing from 10 to 50 men are receiving a great deal of fresh work, which is a sort of reflected industrial activity from the larger industrial concerns. Mining machinery is in great request, and bridge and boat work will crowd the shop and yard capacity.